Food Fortification
A complementary strategy to tackle micronutrient deficiencies

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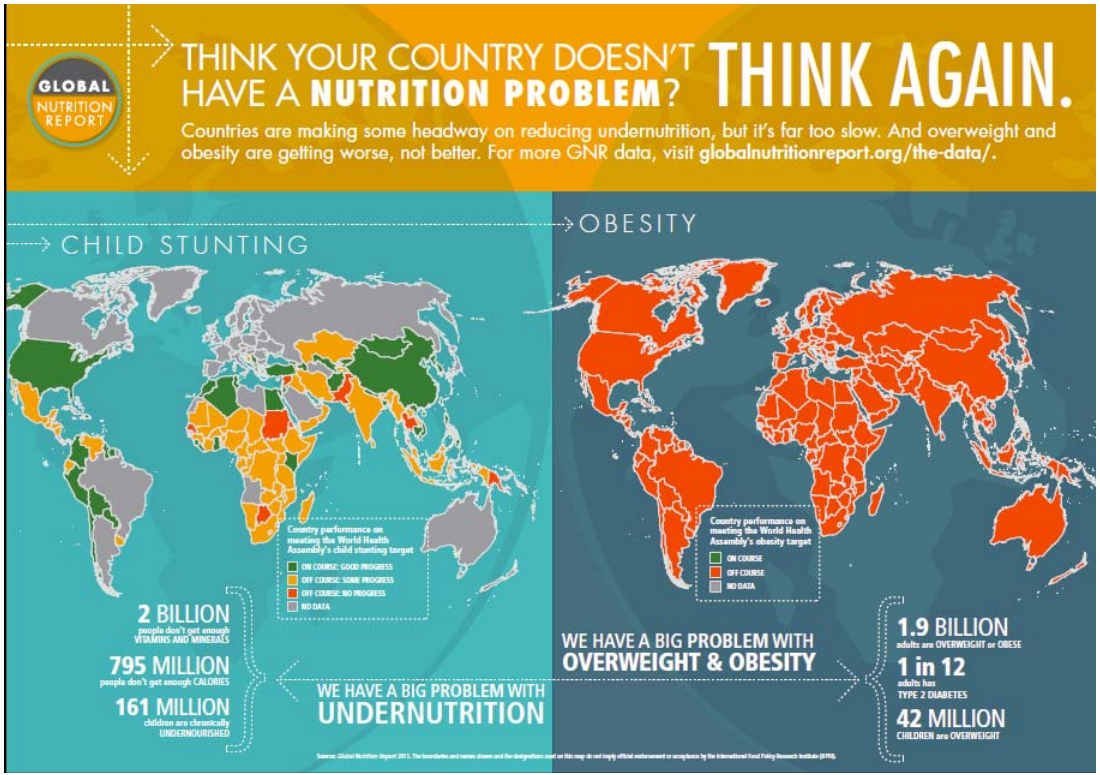
NAMS-NFI Symposium
MDGs Lessons learnt and way forward to SDGs
November 27th, 2015, New Delhi, India

Global Nutrition Challenge

Micronutrient Deficiencies are major public health problem



Vitamin and mineral deficiencies affect nearly 2 billion people worldwide and contribute substantially to Global Burden of Disease

Food fortification is a cost effective and complementary strategy that has helped virtually eliminate many nutrition disorders from the more industrialized countries in the world, but is grossly under-utilized strategy in developing countries

Micronutrients

Zinc

Vitamin D

Cobalt

Iodine

Thiamin

Riboflavin

Vitamin B_6

Vitamin E

Magnesium

Manganese

Iron

Selenium

Folate

Vitamin B_{12}

Niacin

Vitamin A

Phosphorus

Vitamin K

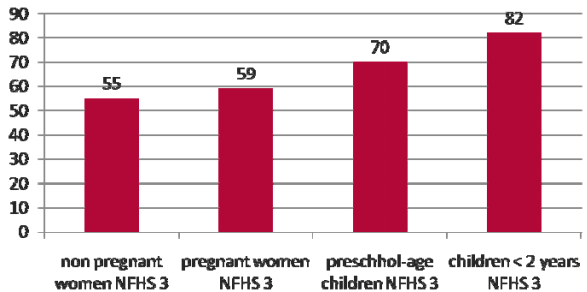
Vitamin C

Cobalamin

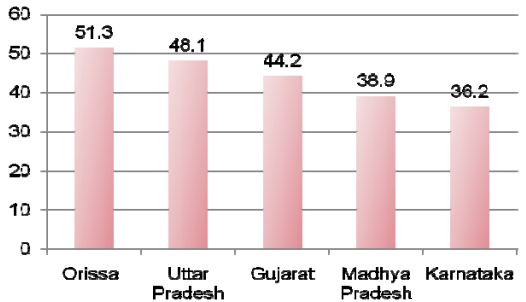
Chromium

Micronutrient deficiencies: A silent emergency in India

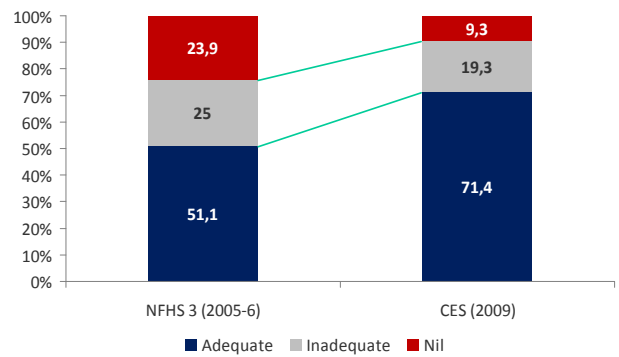
IDA prevalence



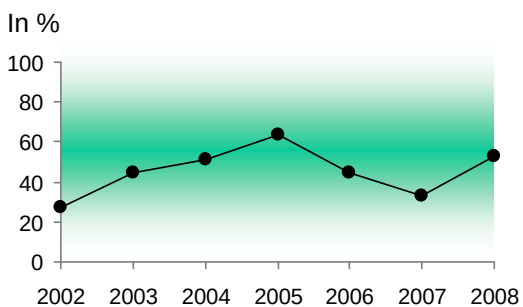
Prevalence of zinc deficiency



Households consuming adequately iodized salt



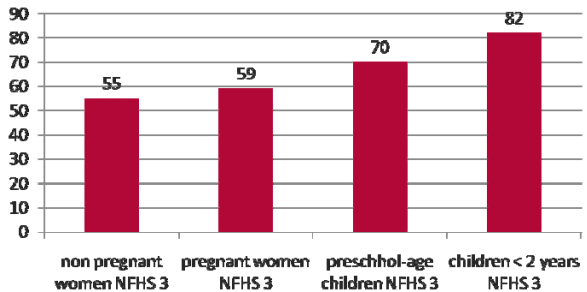
Children 6-59 months receiving two doses of Vitamin A during calendar year



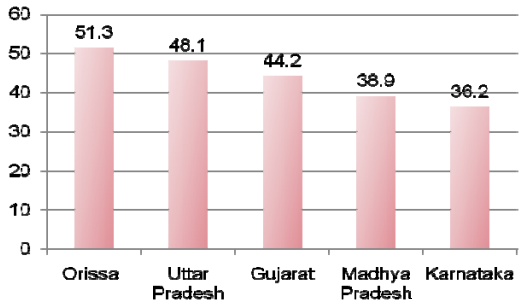
Source: NFHS 3, SOWC 2009, National Iodine Deficiency Control Program, Annual Report (2009-2010). M/o Health and Family Welfare, Govt. of India, New Delhi; Kapil U, Jain K. Magnitude of Zinc Deficiency amongst Under Five Children in India. J Pediatrics. 2011 Feb 12.; Singh B, Dheeravathu SN, Usha K. Micronutrient Deficiency: A global challenge and physiological approach to improve grain productivity under low zinc availability. Plant Stress. 11 November 2010 ; 76-93.

Micronutrient deficiencies: A silent emergency in India

IDA prevalence



Prevalence of zinc deficiency



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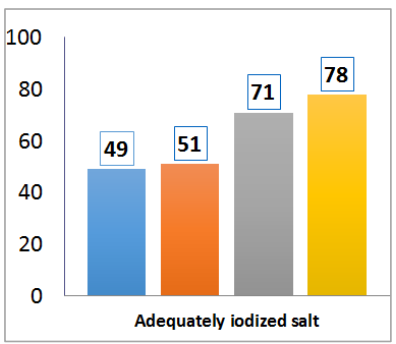

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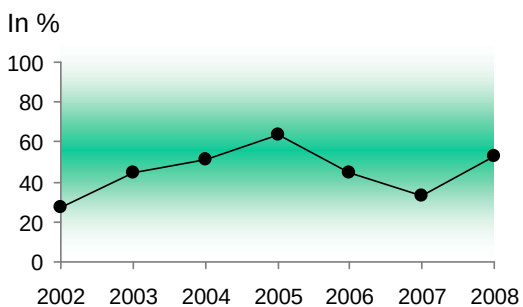

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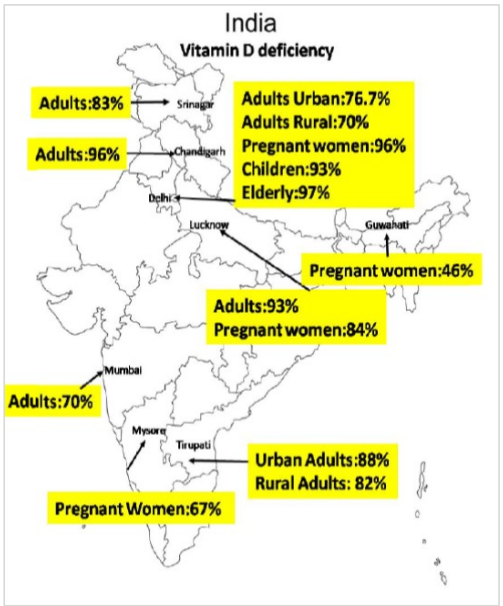
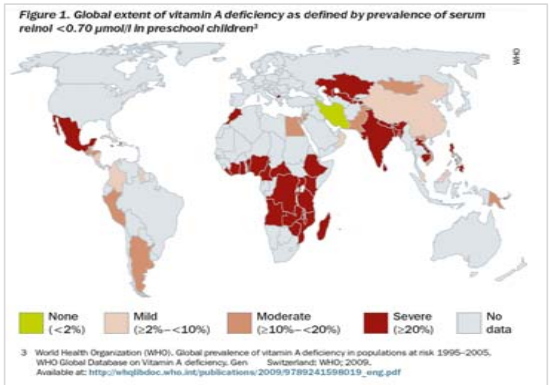
Vitamin A and Vitamin D Deficiency is Widespread in India

- A study published in American Society for Clinical Nutrition, 2005, found 84% of Indian women testing deficient for Vitamin D - having 25 (OH)D levels below 22.5 ng/L
- 59% of the population is deficient in Vitamin D, 25% have very low levels of Vitamin D (Journal of Clinical Endocrinology and Metabolism, March 2010)

- The prevalence of Bitot's spot, the objective sign of clinical VAD (0.8%) higher than WHO cut off for public health significance (0.5%) – NNMB Technical report 22, 2003
- Blood Vitamin A deficiency 61% - 'severe public health problem' as per WHO (20%)
- Proportion of Severe blood VAD 21% - again qualifies as 'severe public health problem as per WHO (5%)





NTD in India

- NTD is the commonest congenital malformation in Indian population
- The incidence varies - 0.5 - 8 / 1000 births
- Significant regional variation in its incidence

Incidence of neural tube defects in the least-developed area of India: a population-based study

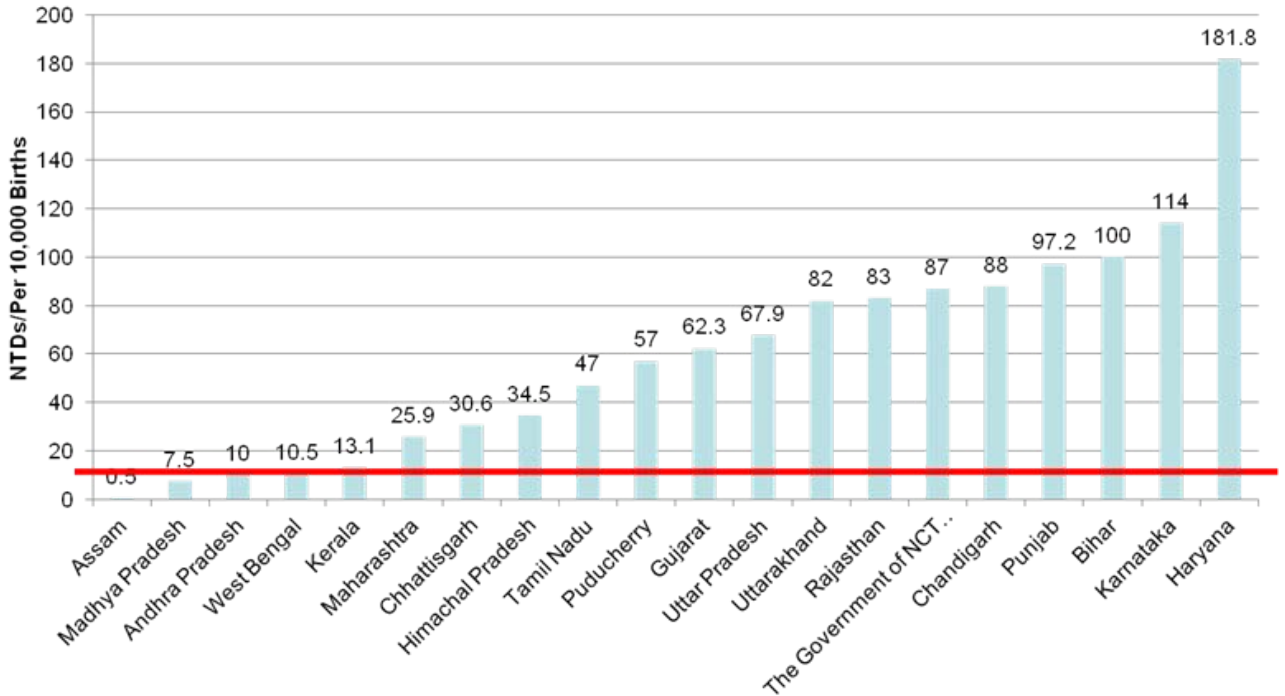
Anil Cherian, Siju Seena, Robyn K Bullock, Ašok C Antony

Lancet 2005; 366: 930–31
See Comment page 871

Emmanuel Hospital Association-Prem Sewa Hospital, Utraula, Balrampur District, Uttar Pradesh, India (A Cherian MBBS, S Seena MSc, R K Bullock RN); Indiana

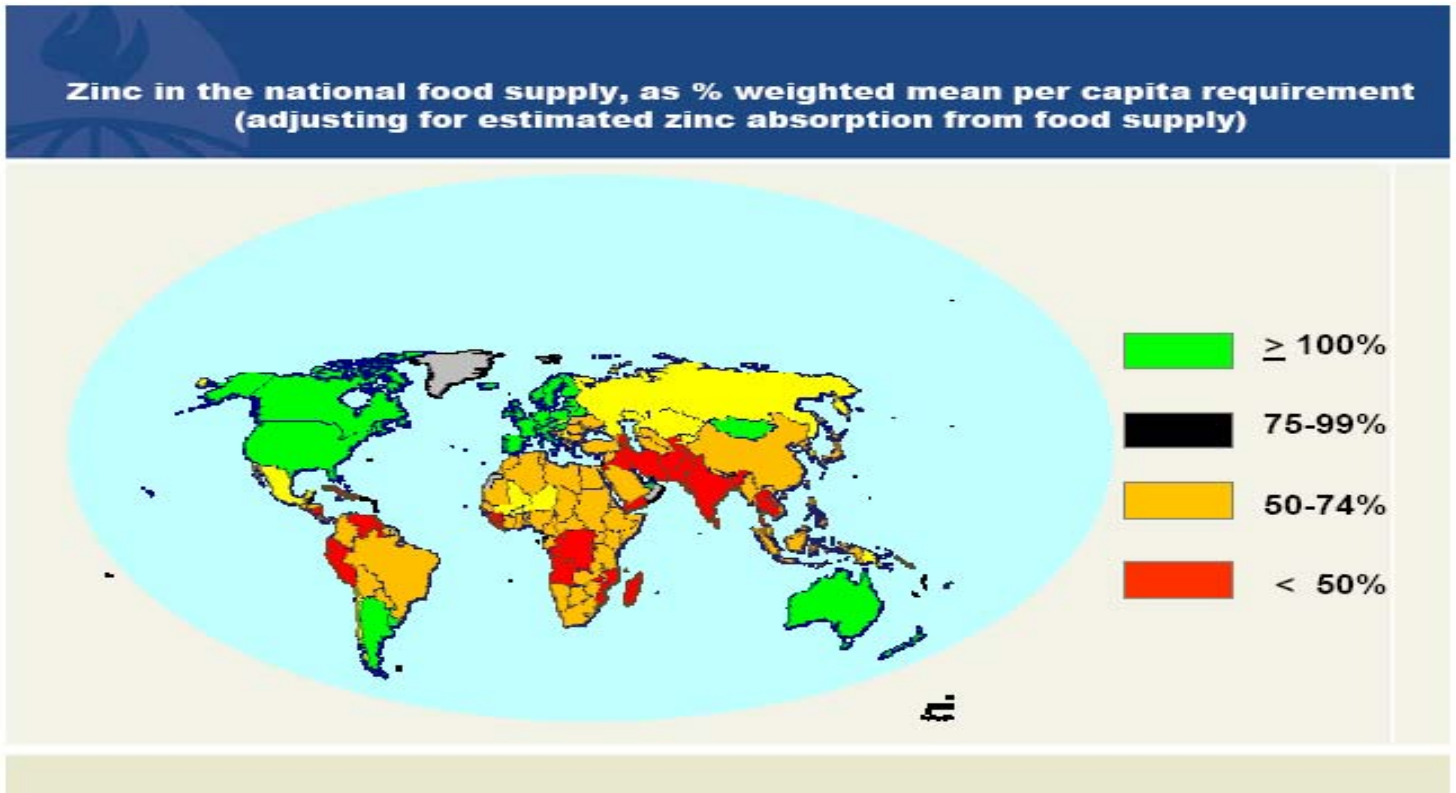
Hospital-based records from major cities of India, where roughly a quarter of the population resides, identified the frequency of neural tube defects (NTDs) as ranging from 3·9 to 8·8 per 1000 births, but the incidence in rural areas is unknown. We did a population-based door-to-door survey of mothers living in remote clusters of villages in Balrampur District in Uttar Pradesh, a region ranked as the least-developed area in India. The data showed that the incidence of NTDs was 6·57–8·21 per 1000 livebirths, which is among the highest worldwide. India's Ministry of Health needs to produce a strategy to reduce the incidence of such defects.

Neural Tube Defects per 10000 births

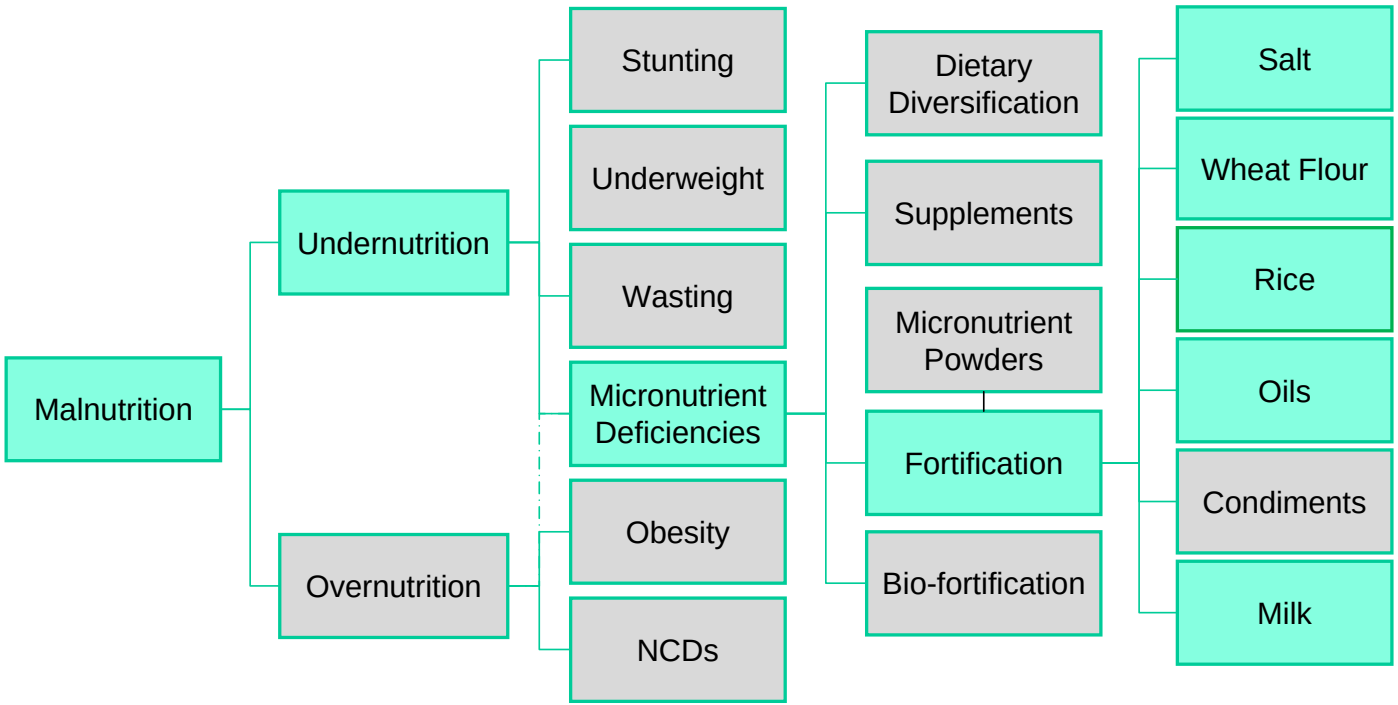


Source : “India Strategy” : Flour Fortification Initiative

Zinc Deficiency



Solution pathway



NCDs: Non-communicable diseases

Micronutrient deficiencies

Dietary diversification

- Median intakes of all the nutrients, except **for thiamine** were below the recommended dietary allowances (RDA) for Indians
- Proportion of HHs not meeting **even 50% of RDA** was 50-81% for riboflavin and vitamin A
- Proportion of **pre-school children** not meeting even 50% of RDA for calcium, vitamin A, riboflavin and vitamin C was about **51- 82%**
- Proportion of **adolescents** not meeting even 50% of RDA for calcium, vitamin A, riboflavin and vitamin C was about **52-85%**

Micronutrient deficiencies

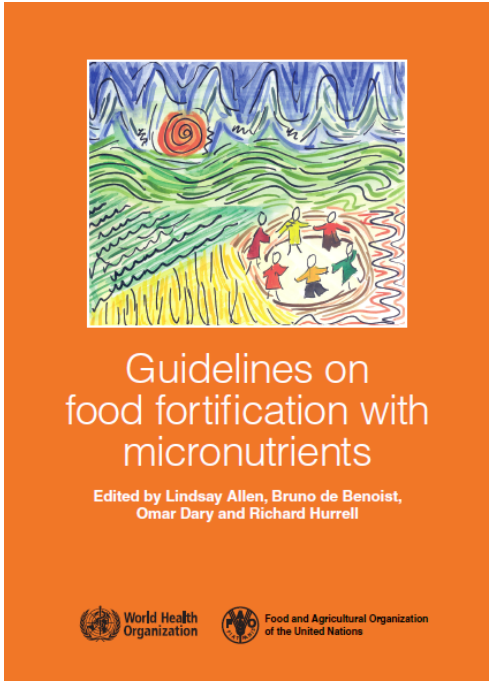
Supplementation

- IFA coverage – received/purchased > 100 tablets **31.2%**
- IFA coverage – consumed 100 or more tab in pregnancy **23.6%**
- IFA coverage in children 6-59 months **13.8%**
- Vitamin A supplementation 6-59 months **46.2%**
- ORS and Zinc in children with diarrhoea **12.6%**

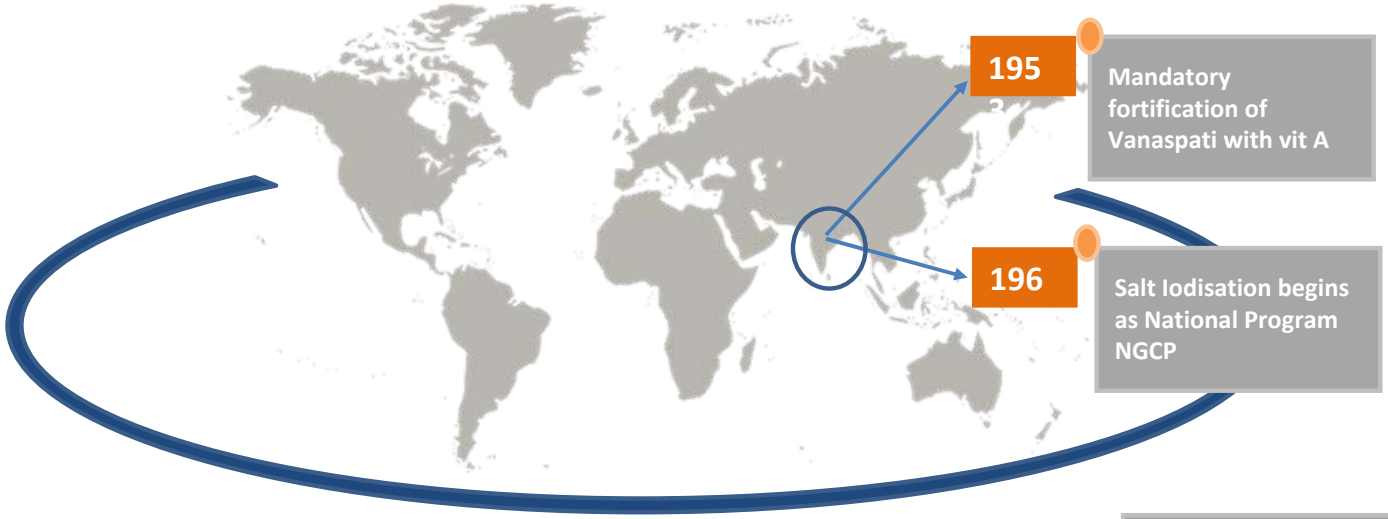
Types of Fortification

- **Mass fortification – Universal**
- **Targeted fortification**
- Market-driven fortification
- Other types of fortification

Mass fortification	**1. Salt** **2. Fats and oils** **3. Wheat flour** **4. Rice** **5. Milk**
Targeted fortification	**1. MNP – children, women** **2. RTE supplementary food**
Market driven	1. Wheat products 2. Beverages 3. Others
Other types of fortification	1. Point of use fortification 2. Fortified dal analogue



Food fortification: Global timeline



195 — Mandatory fortification of Vanaspati with vit A

196 — Salt Iodisation begins as National Program NGCP

1923 — Mandatory salt iodization in Switzerland and USA

1933 — Mandatory fortification of flour with Vitamin B1 in Canada

1934 — Vitamin D fortification of margarine and other dairy products

1940' — Fortification of cereal products with Vitamin B1, B2 and B3 became common practice in many countries. 1941 mandatory fortification with B3 in US

1954 — Flour fortified in Chile with B-vitamins and iron.

1974 — Beginning of sugar fortification with Vitamin A in Guatemala.

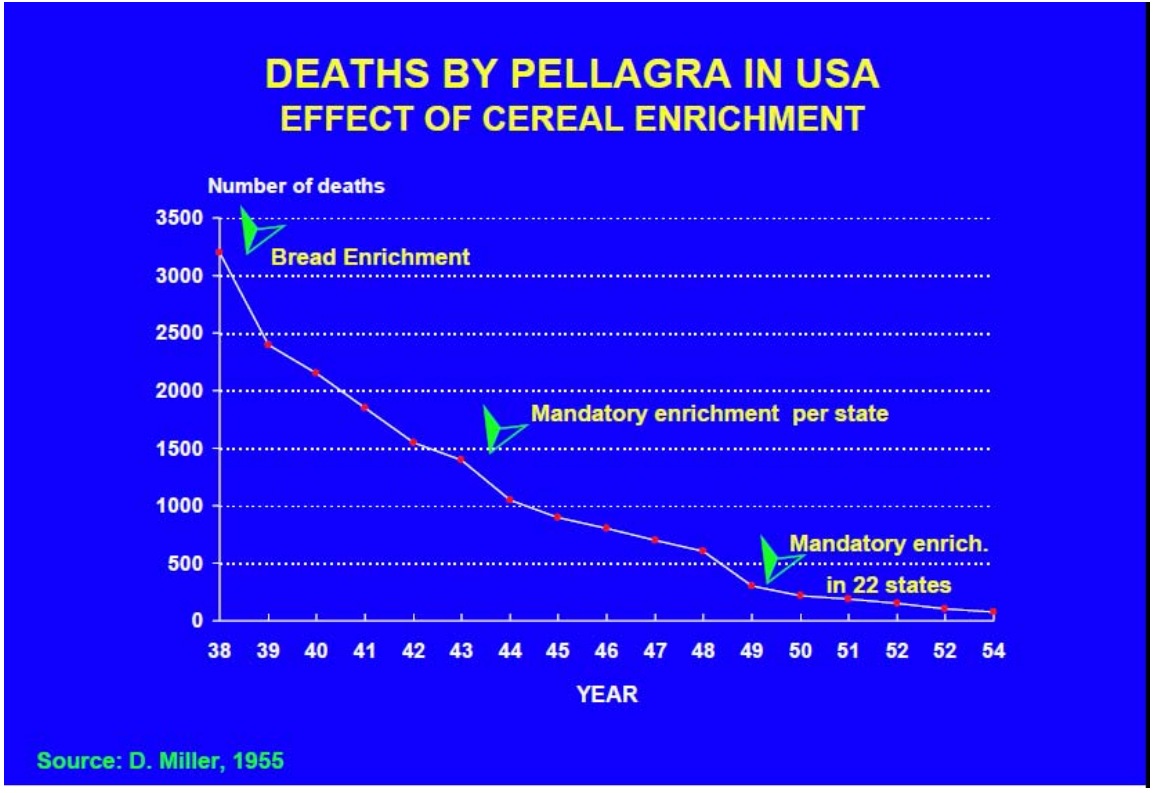
1992 — Wheat and maize flour fortification in Venezuela.

1998 — Folic Acid fortification mandated in the USA

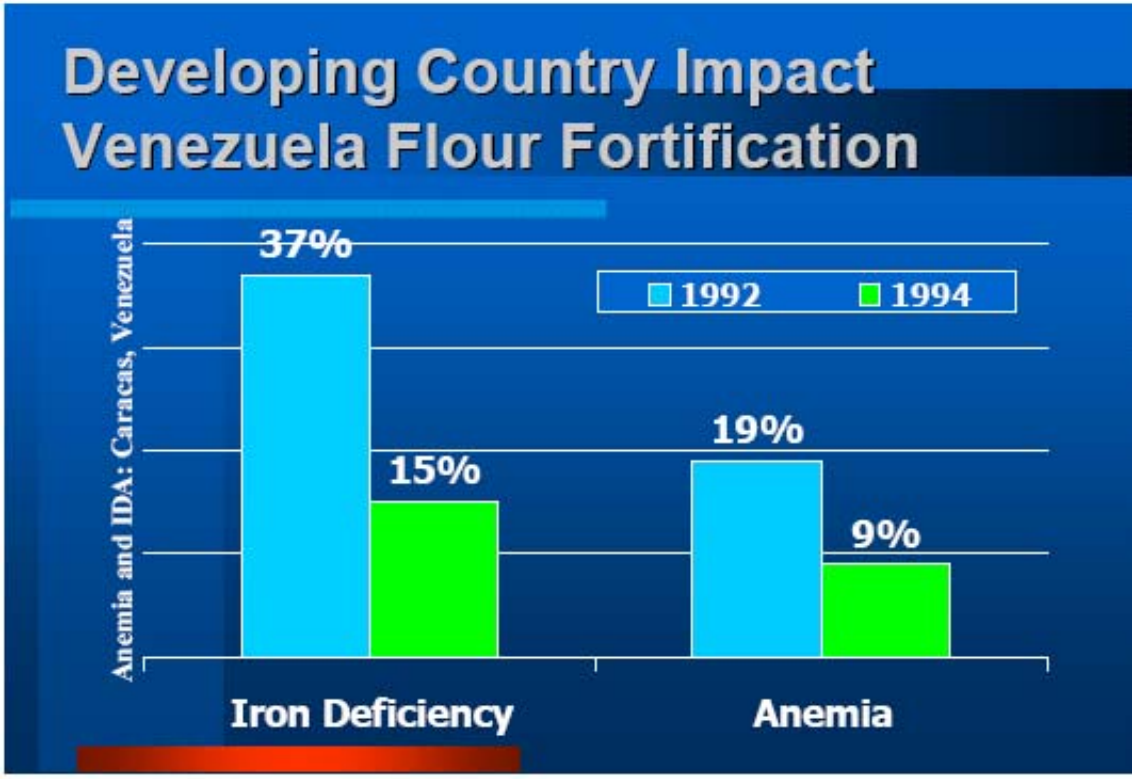
2000 — Mandatory fortification in many countries in Africa – Nigeria

2003 — South Africa mandates fortification of wheat flour, maize meal, brown bread, white bread

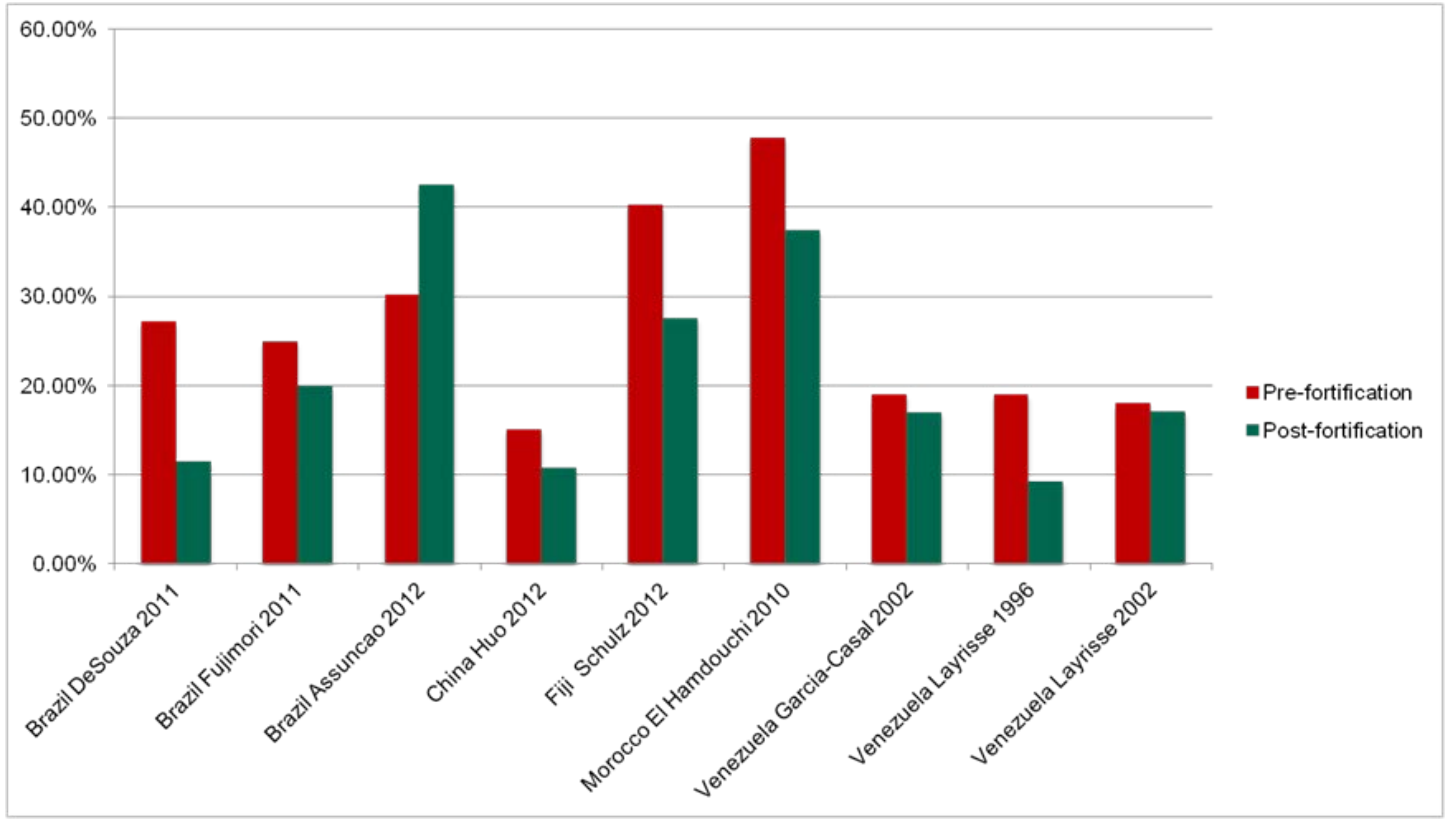
Flour


DEATHS BY PELLAGRA IN USA
EFFECT OF CEREAL ENRICHMENT
Number of deaths
3500
3000
2500
2000
1500
1000
500
0
Bread Enrichment
Mandatory enrichment per state
Mandatory enrich.
in 22 states
38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 52 54
YEAR
Source: D. Miller, 1955

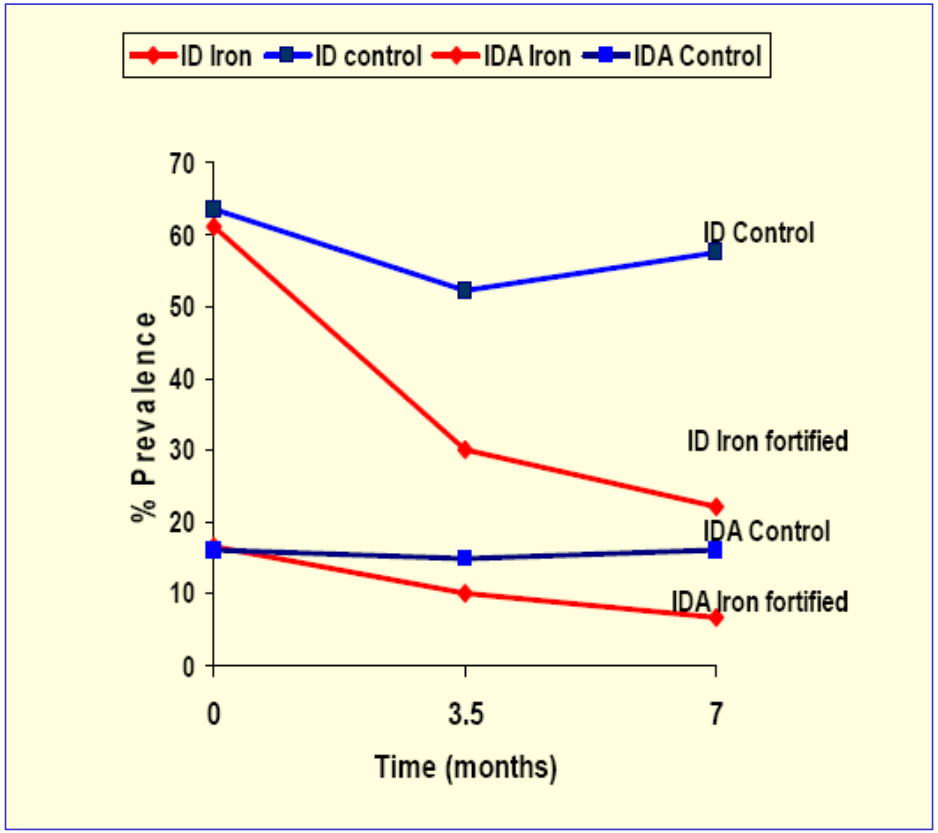
Flour


Developing Country Impact
Venezuela Flour Fortification
Anemia and IDA: Caracas, Venezuela
37%
15%
19%
9%
1992
1994
Iron Deficiency
Anemia

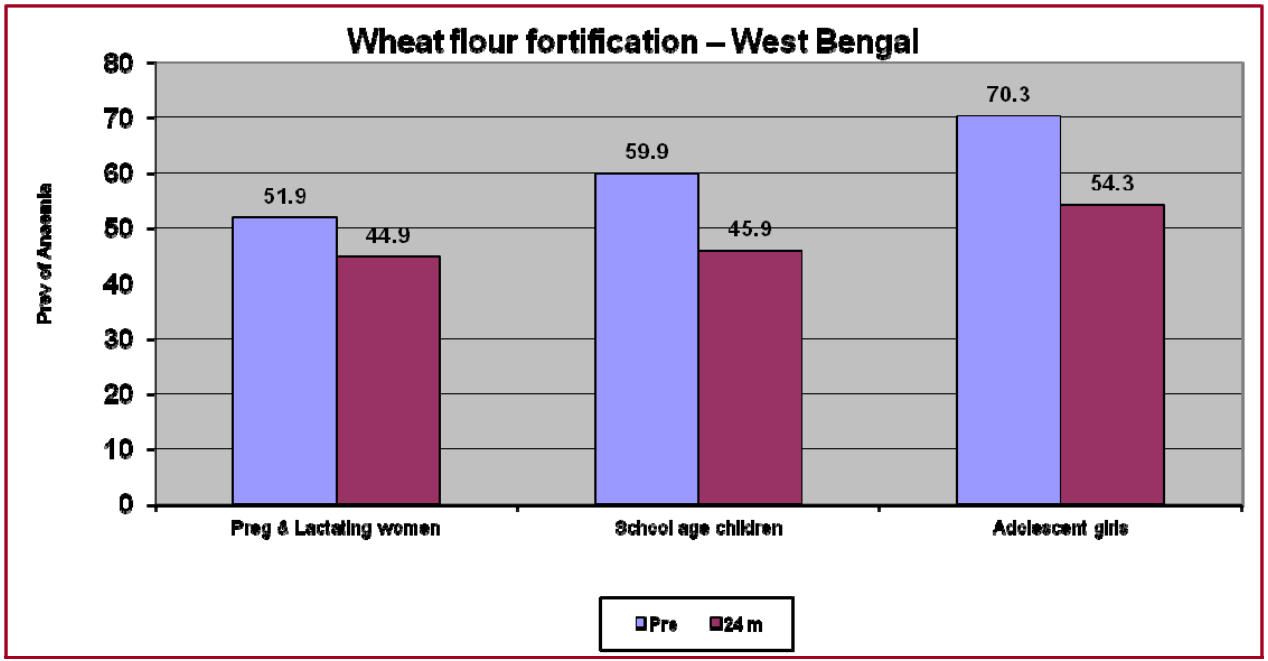
Flour fortification – Iron deficiency Effectiveness Studies



Wheat Flour


ID Iron
ID control
IDA Iron
IDA Control
70
60
50
40
30
20
10
0
% Prevalence
ID Control
ID Iron fortified
IDA Control
IDA Iron fortified
0
3.5
7
Time (months)

Wheat Flour



WFF has picked up momentum in India. Gujarat has been doing it for few years now. Several other state govts are introducing it in PDS and are using it in Mid Day Meal

Flour

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Reduction in Neural-Tube Defects after Folic Acid Fortification in Canada

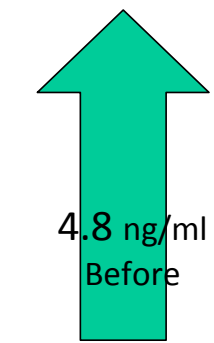
Philippe De Wals, Ph.D., Fassiatou Tairou, M.Sc., Margot I. Van Allen, M.D.,

CONCLUSIONS

Food fortification with folic acid was associated with a significant reduction in the rate of neural-tube defects in Canada. The decrease was greatest in areas in which the baseline rate was high.

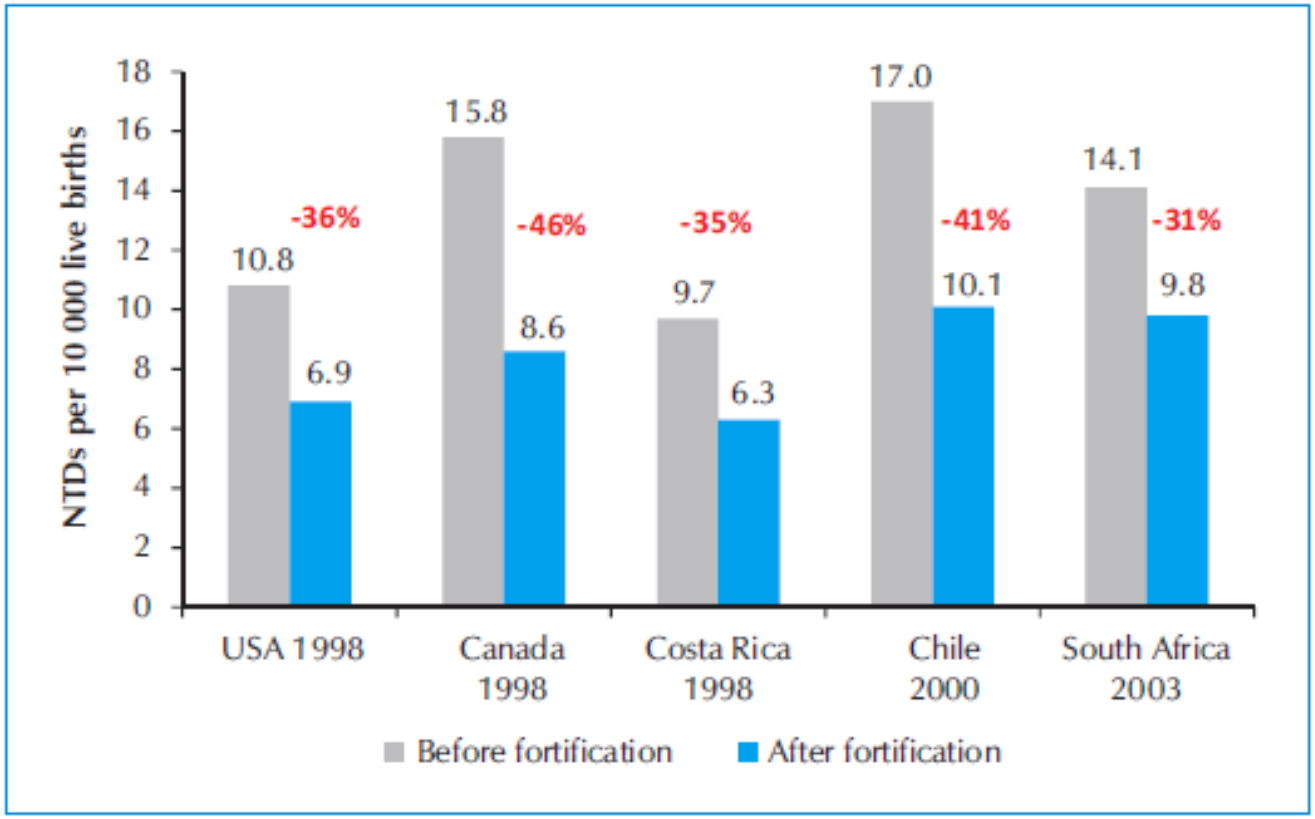
Flour

The Centers for Disease Control and Prevention reported that neural tube defects has decreased by 19 percent following folic acid fortification in the U.S. food supply.

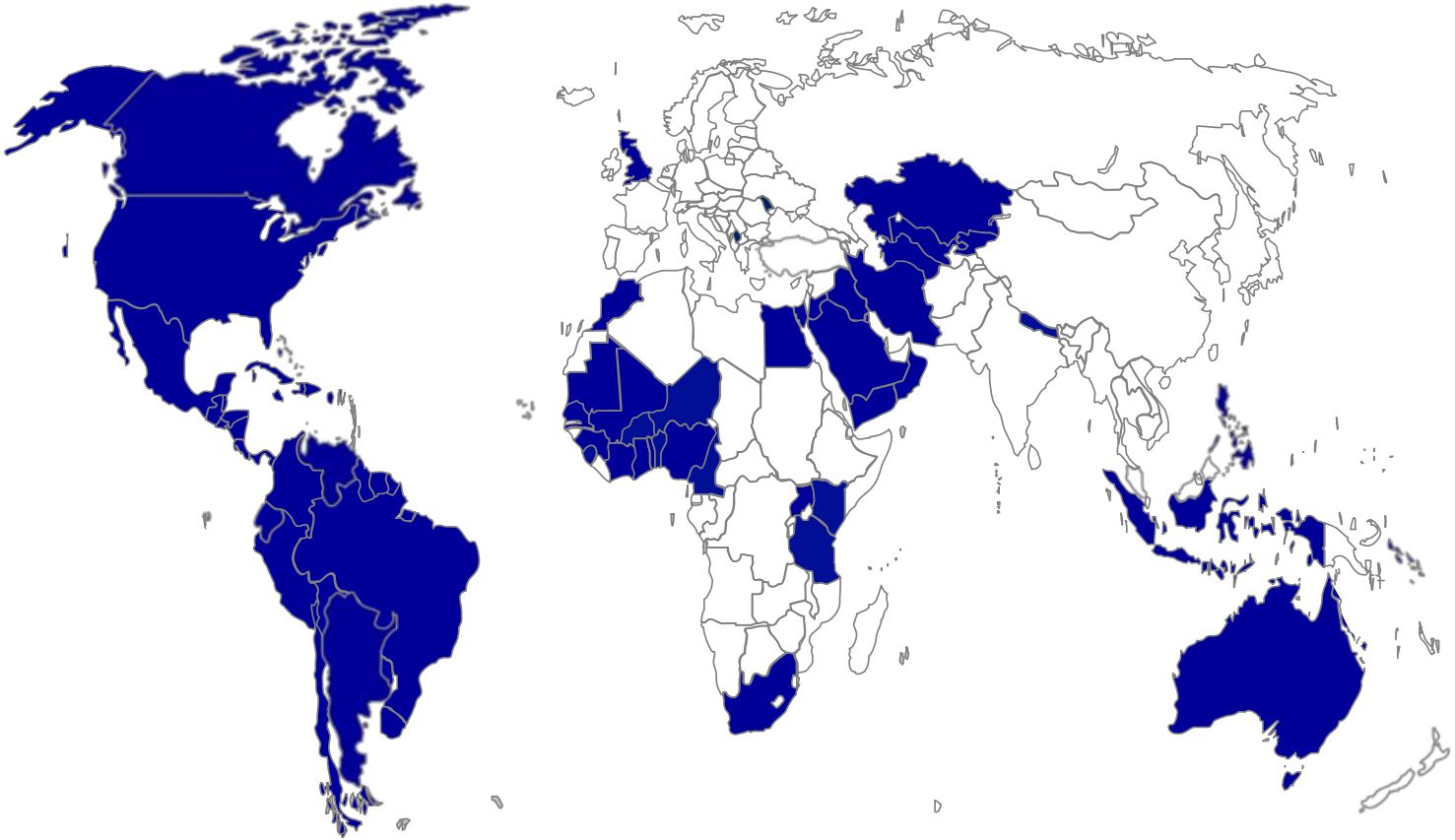


US fortification rapidly increased the serum folate

NTD rates before and after fortification



Wheat Flour Fortification Legislation - mandated in 81 countries



Source: Food Fortification Initiative, 2014. Note: All countries fortify flour with at least iron and folic acid except Australia which does not include iron, and Venezuela, the United Kingdom, and the Philippines which do not include folic acid.

Rice

Bulk of the Research has focused on Iron fortification

	Vehicle	Country	Source/Study Type	Title
Efficacy	Rice	India	American Journal of Clinical Nutrition, 2006	Extruded rice fortified with micronized ground ferric pyrophosphate reduces iron deficiency in Indian schoolchildren: A double-blind randomized controlled trial
Efficacy	Rice	Mexico	Food and Nutrition Bulletin, 2008	Efficacy of iron-fortified Ultra Rice in improving the iron status of women in Mexico
Efficacy	Rice	The Philippines	Journal of Nutrition, 2005	Iron-biofortified rice improves the iron stores of nonanemic Filipino women
Efficacy	Rice*	Brazil	Journal of Nutrition, 2009	Iron-fortified rice is as efficacious as supplemental iron drops in infants and young children
Efficacy	Rice	India	National Institute of Nutrition; Department of Biotechnology, Government of India, 2009	Evaluation of bio-effect of Ultra Rice on iron status of beneficiaries of Mid Day Meal Programme: a study in a primary school of Ranga Reddy district of Andhra Pradesh
Efficacy	Rice	The Philippines	International Journal for Vitamin and Nutrition Research, 2008	Efficacy of Iron-fortified rice in reducing anemia among schoolchildren in the Philippines
Acceptability	Rice	Thailand/Bangladesh	Journal of the Science of Food and Agriculture, 2009	Iron fortification and parboiled rice quality: appearance, cooking quality and sensory attributes
Acceptability	Rice	N/A	International Journal of Food Science and Technology, 2008	Effect of Iron Compounds on the Storage Stability of Multiple Fortified Ultra Rice

Potential for wheat flour fortification

- Widely and regularly consumed
- Technology is simple
- Extensive experience - > 70 years
- Cost effective and proven efficacy and effectiveness
- PDS offtake under NFSA – 60 MMT

World Health Organization

Recommendations on Wheat and Maize Flour Fortification
Meeting Report: Interim Consensus Statement

PURPOSE

This statement is based on scientific reviews prepared for a Flour Fortification Initiative (FFI) technical workshop held in Stone Mountain, GA, USA in 2008 where various organizations actively engaged in the prevention and control of vitamin and mineral deficiencies and various other relevant stakeholders met and discussed specific practical recommendations to guide flour fortification efforts being implemented in various countries by the public, private and civic sector. This joint statement reflects the position of the World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO), The United Nations Children's Fund (UNICEF), Global Alliance for Improved Nutrition (GAIN), The Micronutrient Initiative (MI) and FFI. It is intended for a wide audience including food industry, scientists and governments involved in the design and implementation of flour fortification programs as public health interventions.

BACKGROUND

WHO and FAO published in 2006 the *Guidelines on Food Fortification with Micronutrients* (WHO/FAO, 2006). These general guidelines, written from a nutrition and public health perspective are a resource for governments and agencies implementing or considering food fortification and a source of information for scientists, technologists and the food industry. Some basic principles for effective fortification programs along with fortificants' physical characteristics, selection and use with specific food vehicles are described. Fortification of widely distributed and consumed foods has the potential to improve the nutritional status of a large proportion of the population, and neither requires changes in dietary patterns nor individual decision for compliance. Technological issues to food fortification need to be fully resolved especially with regards to appropriate levels of nutrients, stability of fortificant, nutrient interactions, physical properties and acceptability by consumers (WHO/FAO, 2006). Worldwide, more than 600 million metric tons of wheat and maize flours are milled annually by commercial roller mills and consumed as noodles, breads, pasta, and other flour products by people in many countries. Fortification of industrially processed wheat and maize flour, when appropriately implemented, is an effective, simple, and inexpensive strategy for supplying vitamins and minerals to the diets of large segments of the world's population. It is estimated that the proportion of industrial-scale wheat flour being fortified is 97% in the Americas, 31% in Africa, 44% in Eastern Mediterranean , 21% in South-East Asia , 6% in Europe, and 4% in the Western Pacific regions in 2007 (FFI, 2008).

THE FFI SECOND TECHNICAL WORKSHOP ON WHEAT FLOUR FORTIFICATION

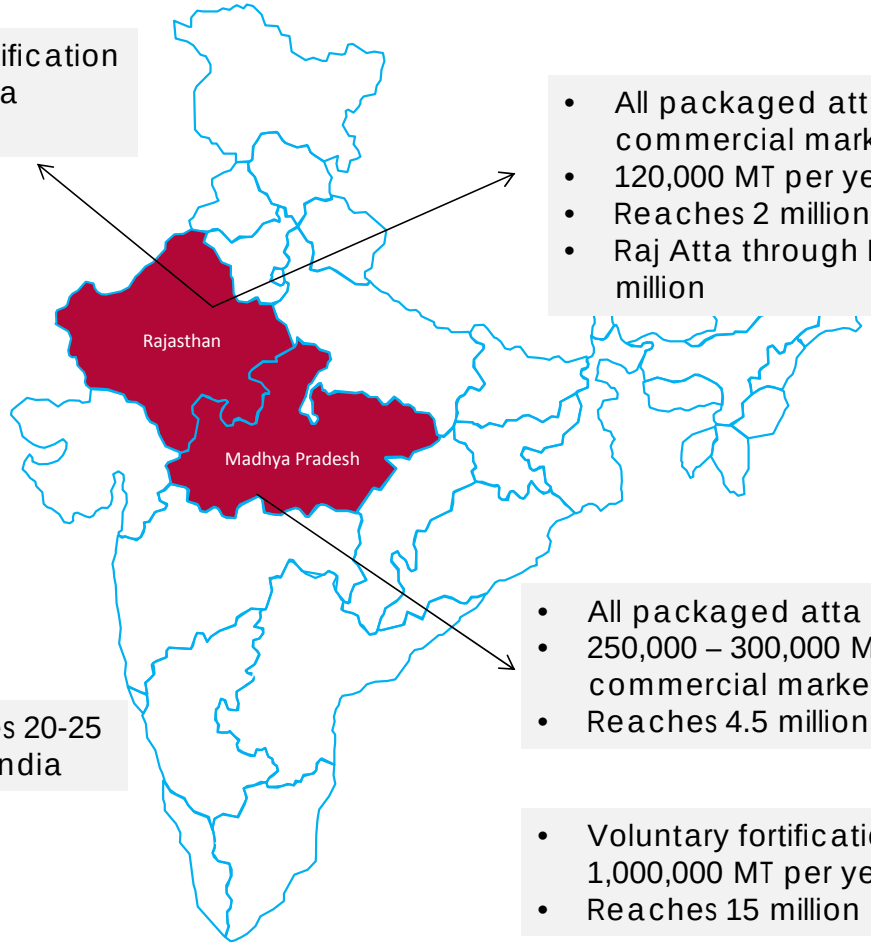
Nearly 100 leading nutrition, pharmaceutical and cereal scientists and milling experts from the public and private sectors from around the world met on March 30 to April 3, 2008 in Stone Mountain, GA, USA to provide advice for countries considering national wheat and/or maize flour fortification. This *Second Technical Workshop on Wheat Flour Fortification: Practical Recommendations for National Application* was a follow up to a FFI, the US Centers for Disease Control and Prevention (CDC) and the Mexican Institute of Public Health, first technical workshop entitled "Wheat Flour Fortification: Current Knowledge and Practical Applications," held in Cuernavaca, Mexico in December 2004 (FFI, 2004). The purpose of this second workshop was to provide guidance on national fortification of wheat and maize flours, milled in industrial roller mills (i.e. >20 metric tons/day milling capacity), with iron, zinc, folic acid, vitamin B_{12} and vitamin A and to develop guidelines on formulations of premix based on common ranges of flour consumption. A secondary aim was to agree on the best practices guidelines for premix manufacturers and millers. Expert work groups prepared technical documents reviewing published efficacy and effectiveness studies as well as the form and levels of fortificants currently being added to flour in different countries. The full reviews will be published in a supplement of *Food and Nutrition Bulletin* in 2009 and the summary recommendations of this meeting can be found in http://www.sph.emory.edu/wheatflour/atlanta08/ (FFI, 2008).

RECOMMENDATIONS FOR WHEAT AND MAIZE FLOUR FORTIFICATION

Wheat and maize flour fortification is a preventive food-based approach to improve micronutrient status of populations over time that can be integrated with other interventions in the efforts to reduce vitamin and mineral deficiencies when identified as public health problems. However, fortification of other appropriate food vehicles with the same and/or other nutrients should also be considered when feasible. Wheat and maize flour fortification should be considered when industrially produced flour is regularly consumed by large population groups in a country. Wheat and maize flour fortification programmes could be expected to be most effective in achieving a public health impact if mandated at the national level and can help achieve international public health goals. Decisions about which nutrients to add and the appropriate amounts to add to fortify flour should be based on a series of factors including the nutritional needs and deficiencies of the population; the usual consumption profile of "fortifiable" flour (i.e. the total estimated amount of flour milled by

Wheat flour fortification in India

- Chakki level fortification in 200 villages – a successful pilot



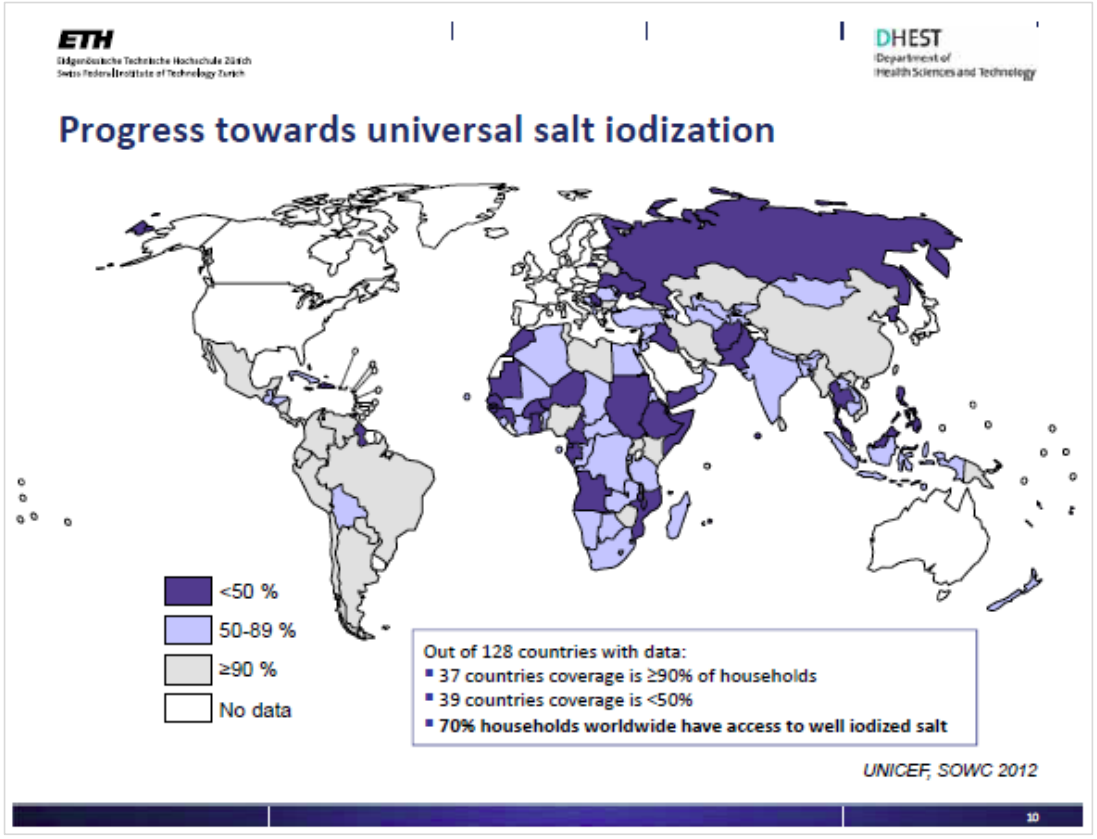
- All packaged atta sold through commercial market is fortified
- 120,000 MT per year
- Reaches 2 million
- Raj Atta through PDS reached 11 million

- All packaged atta is fortified
- 250,000 – 300,000 MT is sold through commercial market channels
- Reaches 4.5 million people

Fortified atta reaches 20-25 million persons in India

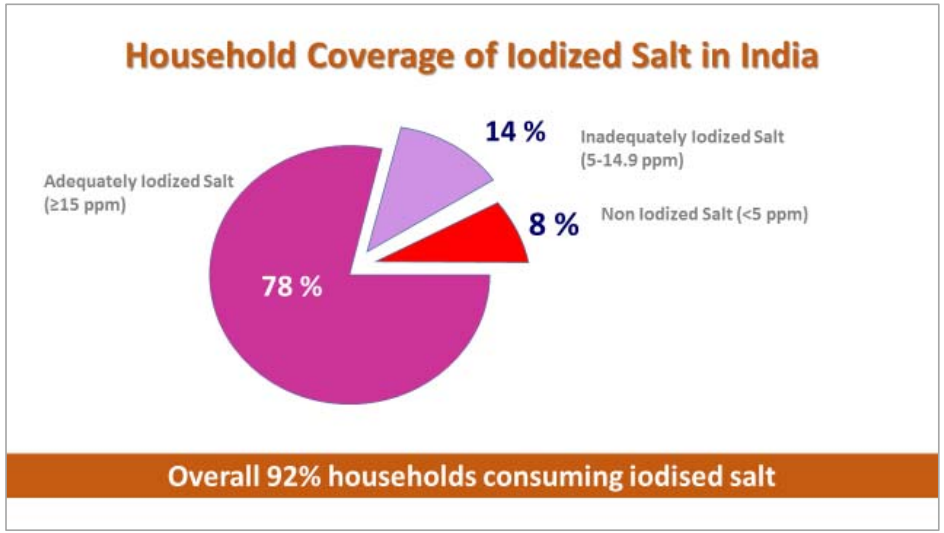
- Voluntary fortification by industry – 1,000,000 MT per year
- Reaches 15 million

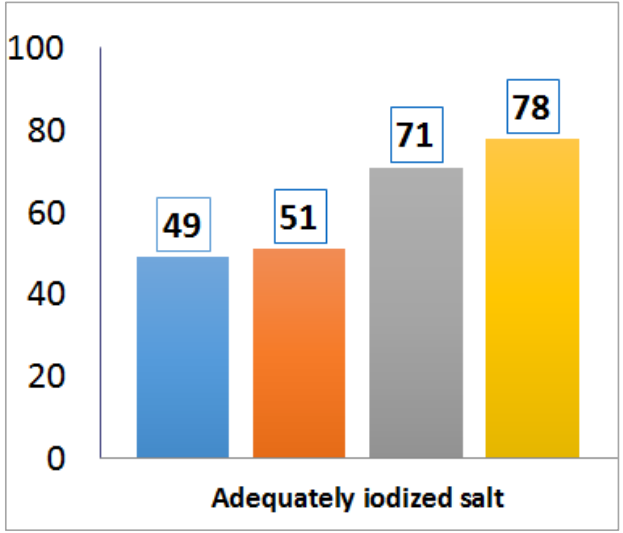
Universal Salt Iodisation



Summary Findings

- Progress achieved during the last decade is remarkable
- The results of the survey constitute an unprecedented success
- This optimism however need to be tempered





DFS – Iodine and Iron fortified salt

1. Fortification of common salt with iron: effect of chemical additives on stability and bioavailability. Rao BS, Vijayasarathy C. ***Am J Clin Nutr. 1975 Dec;28(12):1395-401***.

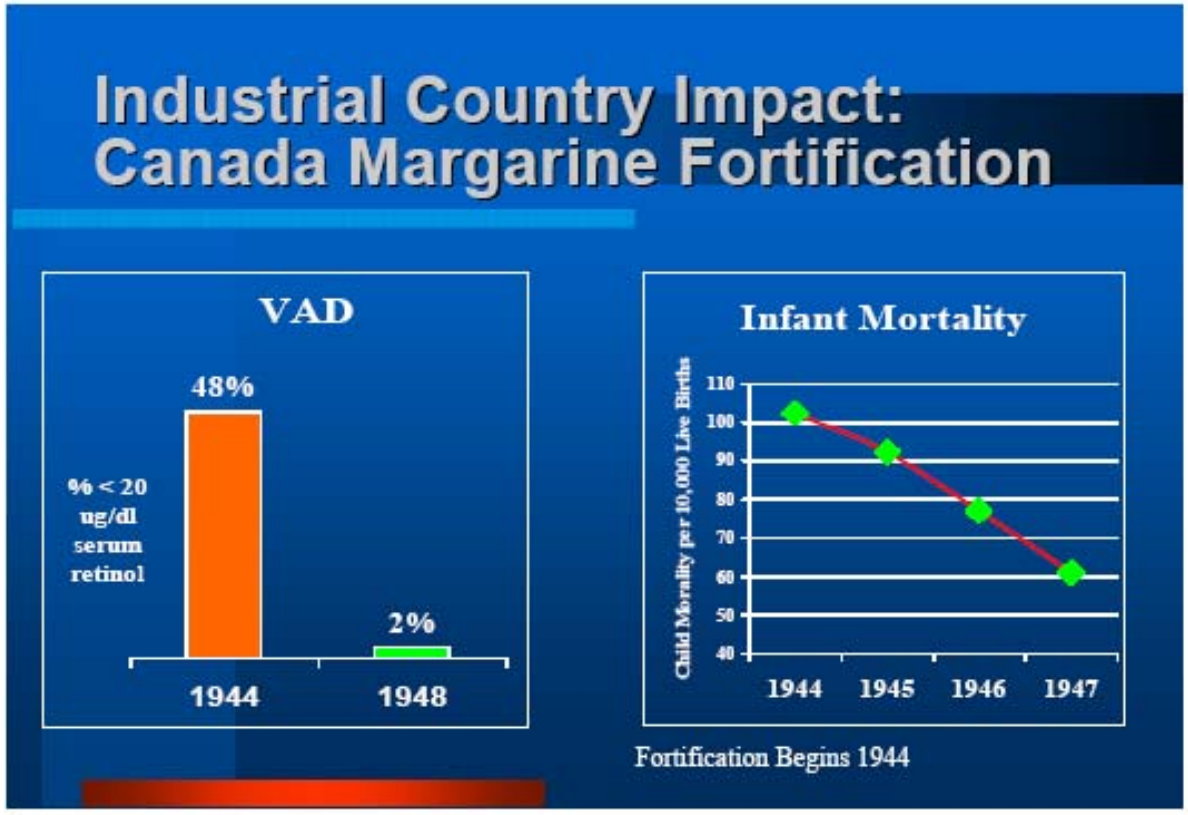
2. The use of common salt (sodium chloride) fortified with iron to control anaemia: results of a preliminary study. Nadiger HA, Krishnamachari KA, et al. ***Br J Nutr. 1980 Jan;43(1):45-51***.

3. Fortification of salt with iron and iodine to control anaemia and goitre: Development of a new formula with good stability and bioavailability of iron and iodine, Bagepalli S. Narasinga Rao; ***The United Nations University Press; Food and Nutrition Bulletin; Volume 15 (1993/1994), number 1, March 1994.***

4. Impact evaluation of iron & iodine fortified salt. Nair KM, Brahmam GN, Ranganathan S, et al. ***Indian J Med Res. 1998 Nov;108:203-***11.

5. Dual fortification of salt with iodine and iron: a randomized, doubleblind, controlled trial of micronized ferric pyrophosphate and encapsulated ferrous fumarate in southern India. *M Andersson, P Thankachan, S Muthayya, et al.* **Am J Clin Nutr 2008;88:1378–87**

Fats and oil


Industrial Country Impact:
Canada Margarine Fortification
VAD
48%
% < 20 ug/dl serum retinol
2%
1944
1948
Infant Mortality
Child Morality per 10,000 Live Births
110
100
90
80
70
60
50
40
1944
1945
1946
1947
Fortification Begins 1944

Oil Fortification

SUSTAIN

SHARING UNITED STATES TECHNOLOGY TO AID IN THE IMPROVEMENT OF NUTRITION

Vitamin A Fortification of P.L. 480 Vegetable Oil

The stability of vitamin A in oil is greater than other currently used food vehicles such as flour, sugar or corn soy blends. Losses are estimated at 5% during shipping and 10% during open storage in the field. Cooking losses will range from 5% for boiling or simmering to 20% when the food is fried. Higher losses, over 50%, would occur with very high temperature and/or repeated frying, but this type of application is not believed to be common with PL 480 vegetable oil.

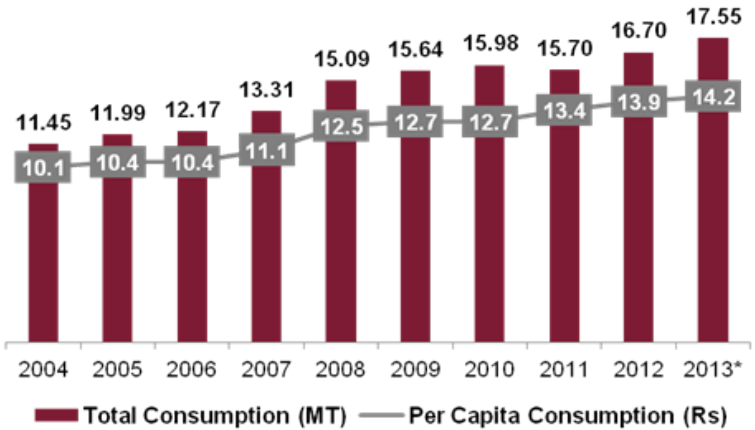
Oil Fortification

Stability of Vitamin A in fortified oil after repeated frying of potatoes at 180°C
(Average of 2 replicates)

Number of frying	% Vitamin A retained	
	33.3 IU/G	66.6 IU/g
1	90.5	93.5
2	87.0	86.5
3	77.5	82.0
4	72.5	76.5
5	68.0	70.5

M. RAHMANI *Institut Agronomique et Vétérinaire Hassan II Rabat / MOROCCO*
H. AGUENAOU *Faculté des Sciences Kénitra / MOROCCO*

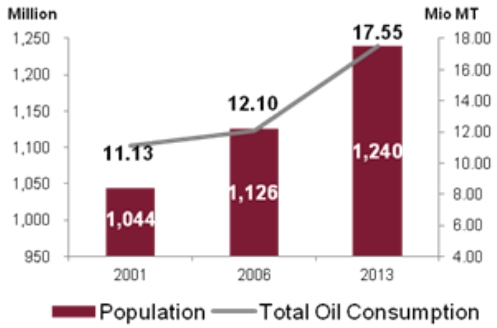
Potential for edible oil fortification



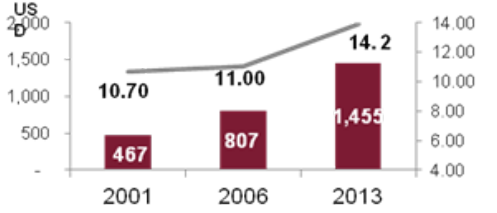
Source: OECD – FAO Estimates + NCAER & SEA estimates

- Domestic edible oil market: Est. at $15 billion & set to grow at 5-6% annually.
- Demand for edible oils is projected to rise to 25 MMT in near future moving in tandem with the avg. per capita income growing at 4-6%.
- Refined oil accounts for over third of total oil consumption with a market size of 5 MMT & is growing 15% annually.

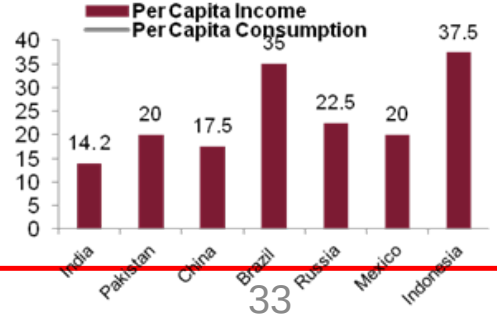
Edible Oil consumption @ 17.55 MMT in line with population growth.



Getting turbo charged by growing per capita income.

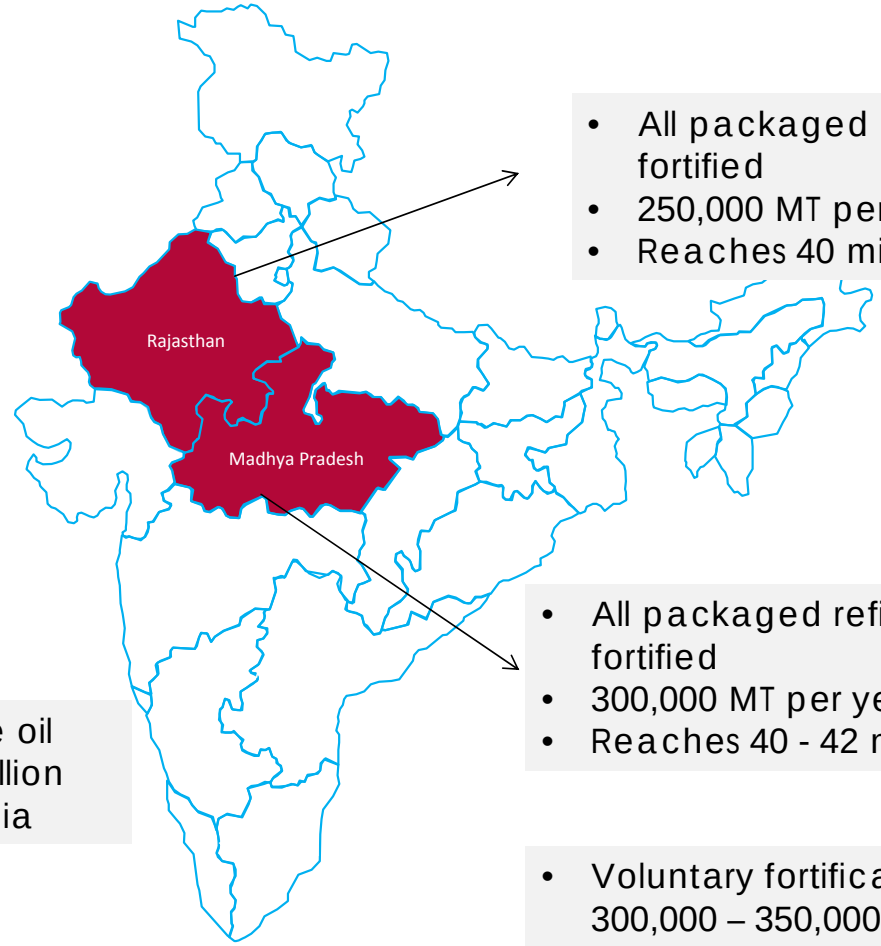


At 14. 2 kgs per capita edible oil consumption in India is much lower than global average of 20 kgs.



33

Edible oil fortification in India



- All packaged refined oil is fortified
- 250,000 MT per year
- Reaches 40 million

- All packaged refined oil is fortified
- 300,000 MT per year
- Reaches 40 - 42 million

Fortified edible oil reaches 125 million persons in India

- Voluntary fortification by industry 300,000 – 350,000 MT per year
- Reaches 42-45 million

Milk

Efficacy of food fortification on serum 25-hydroxyvitamin D concentrations: systematic review[1–4]

Siobhan O'Donnell, Ann Cranney, Tanya Horsley, Hope A Weiler, Stephanie A Atkinson, David A Hanley, Daylily S Ooi, Leanne Ward, Nick Barrowman, Manchun Fang, Margaret Sampson, Alexander Tsertsvadze, and Fatemeh Yazdi

Vitamin D fortification in the United States and Canada: current status and data needs[1–4]

Mona S Calvo, Susan J Whiting, and Curtis N Barton

Fluid milk is the only food that is routinely fortified with vitamin D. In the United States and Canada fortified milk and ready to eat cereals are the predominant food sources of vitamin D

Milk fortification - Effective public health strategy

Efficacy of food fortification on serum 25-hydroxyvitamin D concentrations: systematic review[1–4]

Siobhan O'Donnell, Ann Cranney, Tanya Horsley, Hope A Weiler, Stephanie A Atkinson, David A Hanley, Daylily S Ooi, Leanne Ward, Nick Barrowman, Manchun Fang, Margaret Sampson, Alexander Tsertsvadze, and Fatemeh Yazdi

Am J Clin Nutr 2008;88:1528–34.

This systematic reviewed showed that fortification of foods with vitamin D was associated with statistically significant improvements in serum 25(OH)D concentrations that have important implications for the maintenance of vitamin D status in the population.

Milk fortification - Effective public health strategy

Impact of vitamin D fortified milk supplementation on vitamin D status of healthy school children aged 10-14 years.

Khadgawat R[1], Marwaha RK, Garg MK, Ramot R, Oberoi AK, Sreenivas V, Gahlot M, Mehan N, Mathur P, Gupta N

Vitamin D fortification in the United States and Canada: current status and data needs[1–4]

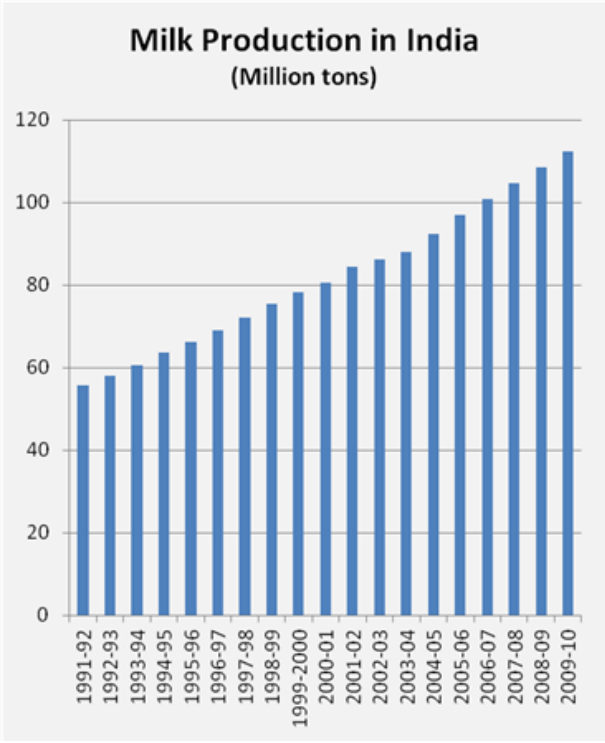
Mona S Calvo, Susan J Whiting, and Curtis N Barton

Effects of fortified milk on morbidity in young children in north India: community based, randomised, double masked placebo controlled trial

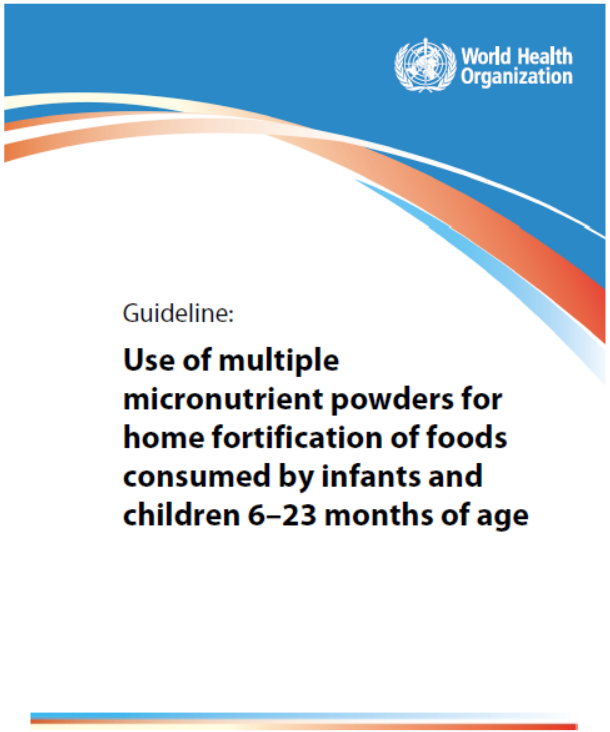
Sunil Sazawal[1], Usha Dhingra[1], Girish Hiremath[1], Jitendra Kumar[2], Pratibha Dhingra[2], Archana Sarkar[2], Venugopal P Menon[2], Robert E Black[1]

Potential for milk fortification

- Indian dairy industry has progressed from a situation of scarcity to that of plenty
- India is now the largest milk producer in the world
- Annual production is >132 million tons
- Milk production quadrupled between 1974 and 2006 - Operation floods
- Per capita availability is 236 ml/day
- Per capita production is projected to increase to > 350 ml/day by 2020

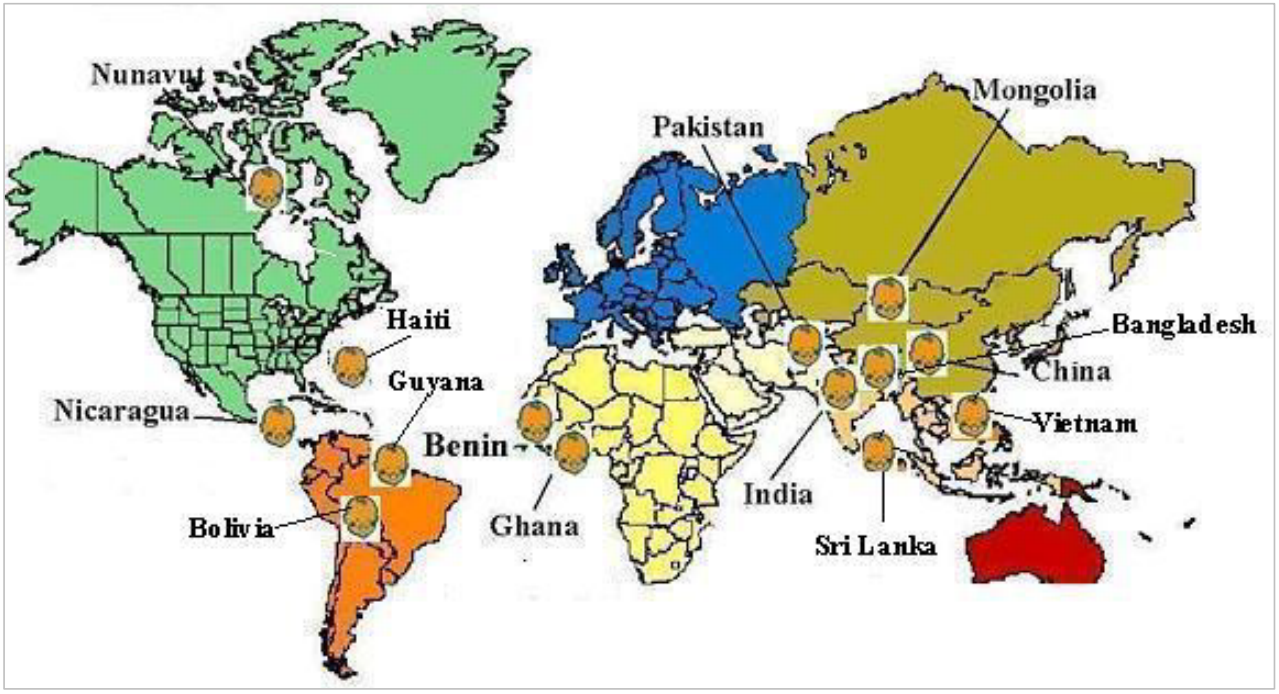


Point of use fortification - MNPs

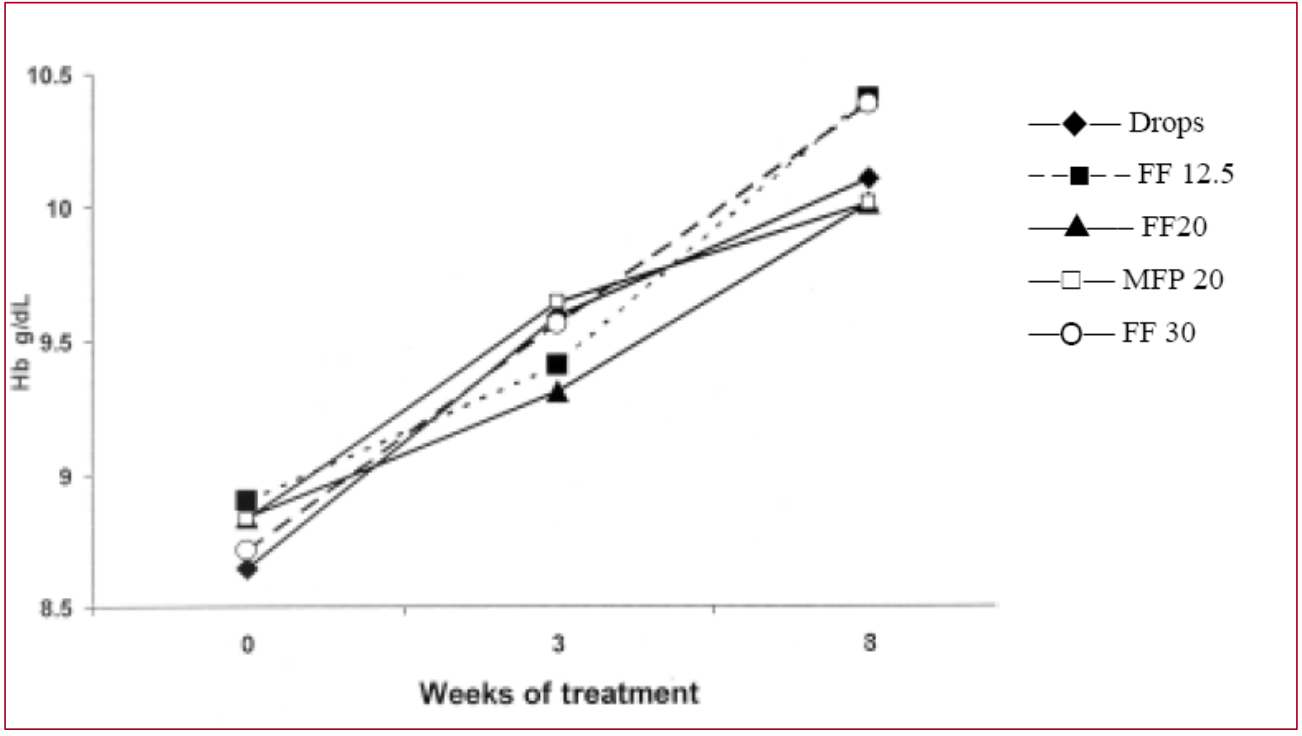


Point of use fortification

Efficacy of MNPs established world wide



Food fortification in India



Indian Pediatr 2007:44;91-100

Food fortification in India

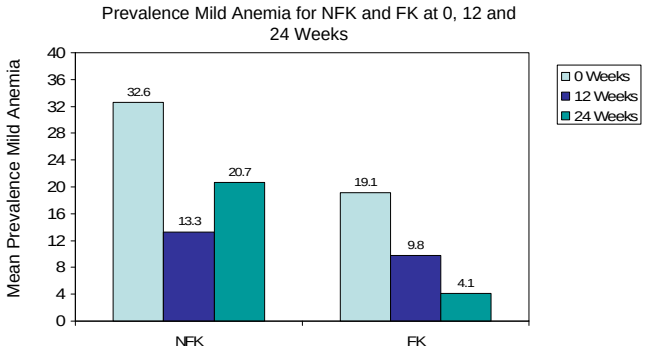
Enhancements to Nutrition Program in Indian Integrated Child Development Services Increased Growth and Energy Intake of Children[1,2]

Rasmi Avula,[3]* Edward A. Frongillo,[3]* Mandana Arabi,[4] Sheel Sharma,[5] and Werner Schultink[4]

J. Nutr. doi: 10.3945/jn.109.116954.

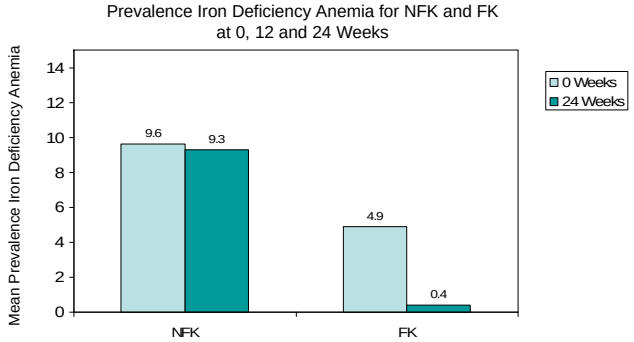
1. A quasi experimental longitudinal design was used
2. 15 AWCs with 'enhanced' program and 15 with normal program
3. Multilevel linear regression was used to examine changes over time
4. The enhanced program significantly increased growth in WAZ and HAZ

Point of use fortification - ICDS



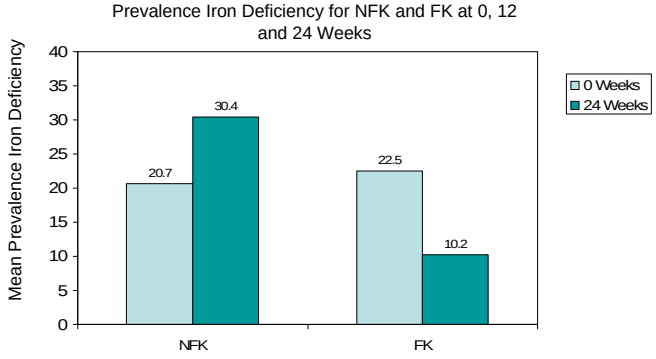
Anaemia

Treatment Group



IDA

14mg microencapsulated ferrous fumarate, 500IU's Vitamin A (acetate 250 CWS) and 0.05mg folic acid per 25g serving



Iron Deficiency

Am J Clin Nutr 2007:85;1127-33

Food fortification in India Opportunities

Staple food fortification

Edible oil	**350-400 million**
Wheat flour – commercial	200 million
PDS	300 million
Milk	300 million

Through government programs

① PDS – potential reach is 800 million

② MDM – potential reach is 150 million

③ ICDS – potential reach is 90 million

Through commercial market

① Increasing market share in the urban and peri urban areas

② Progressively increasing rural market share

③ More women in workforce and higher disposable income are other drivers

Impact at national level

Denmark, Sweden, Finland – 10 -20 % of iron intake was from fortified foods

Hallberg L, et al. Nutr Dieta 1989;44:94-105.

German children 2-13 yrs – 60% of iron intake in 1987 was from fortified foods and increased to 78% in 1995.

Sichert-Hellert W. et al. Eur J Clin Nutr 2000;54:81-86.

Nationally representative data in USA – in women of reproductive age, 40% of total iron intake was from fortified ready-to-eat cereals

Ramakrishnan U, et al. FASEB J 2001;15:748.8

Fortified foods are major contributors to nutrient intakes in Diets of US Children and Adolescents

Academy of Nutrition and Dietetics 2014

Impact at national level

British Journal of Nutrition (2007), **97**, 1177–1186
doi: 10.1017/S0007114507669207
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The impact of voluntary fortification of foods on micronutrient intakes in Irish adults

Evelyn M. Hannon*, Mairead Kiely and Albert Flynn
Irish Universities Nutrition Alliance, Department of Food and Nutritional Sciences, University College Cork, Cork, Republic of Ireland

(Received 27 July 2006 – Revised 29 November 2006 – Accepted 4 December 2006)

British Journal of Nutrition (2007), **97**, 1051–1052
doi: 10.1017/S0007114507709121
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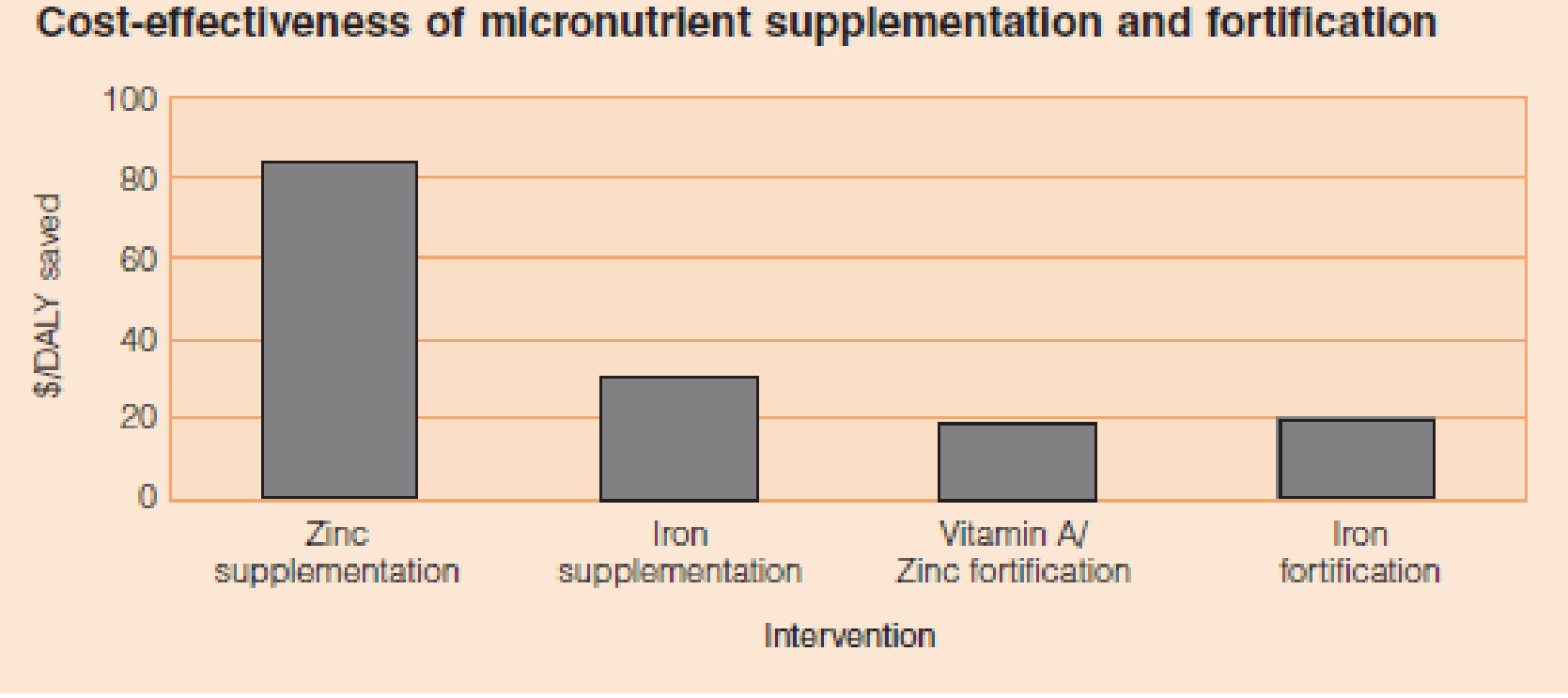
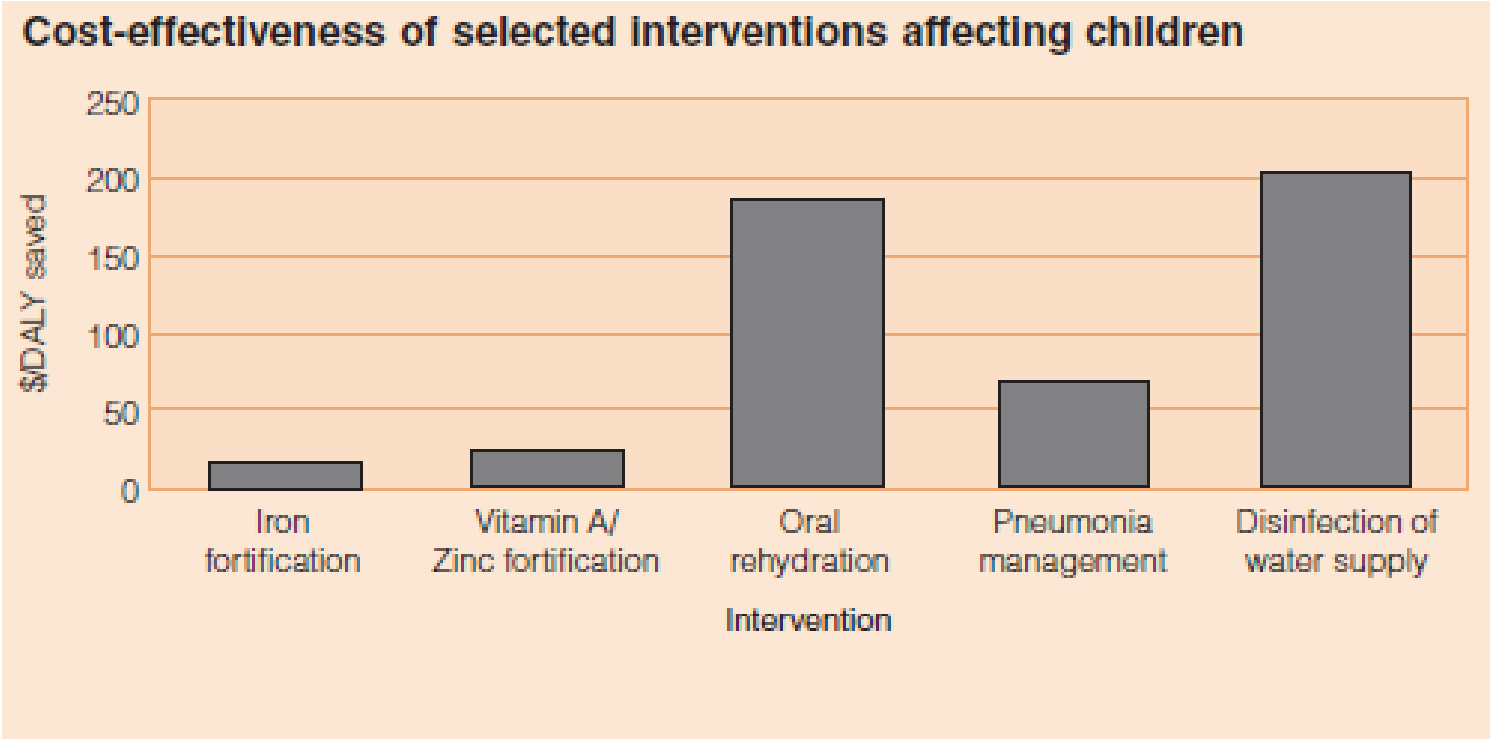
Invited Commentary

Further evidence that food fortification improves micronutrient status

Cost-effectiveness



Cost-effectiveness



Food Fortification as a Strategy for Nutrition Delivery

Critical Factors for Success

Critical success factors

Choosing a vehicle

Food Industry and market related

Food laws and regulation

Building PPP and alliances

Critical success factors

Choosing a vehicle

- Food consumption data for potential food vehicle(s)
- Marketing and distribution data for the food vehicles(s)
- Determining the technical and economic feasibility

Critical success factors

- Food Industry and market analysis
  - Industry capacity & concentration
  - Public – private share and role
  - Investment climate for food fortification

Critical success factors

- Food laws and regulation
  - Voluntary fortification
  - Mandatory fortification
  - Monitoring and enforcement
  - Role of Govt & Food Industry

Critical success factors

Barriers - Consumers

- Nutrition Low Purchase Priority
- Price Sensitivity
- No Perceived Need. *Hidden Hunger*
- Prevention & Future Benefits

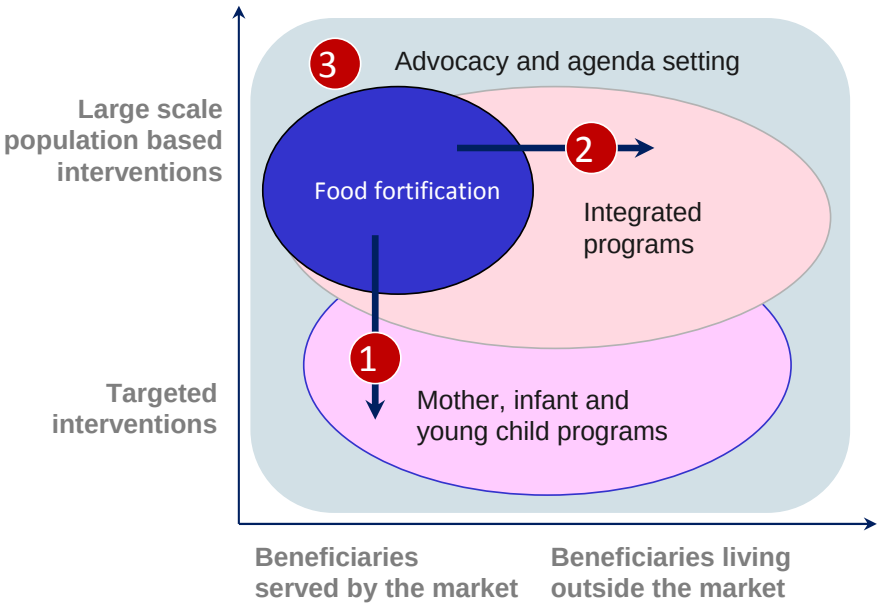
The most at risk choose
the least expensive product

Critical success factors

- Barriers - Producers
  - Little Price or Volume Increase
  - Competition and Price Pressure
  - Low Profit Margins
  - Low Capacity Utilization

It is not the Cost
It is the Competition

complementary strategy



1. targeted interventions
   - needed to few physiological groups and during critical periods
2. Convergence with other impactful interventions and sectors is absolutely necessary
3. Agenda setting and advocacy to ensure nutrition being adequately addressed is also critical for success

Integrated approaches needed to ensure most vulnerable populations are reached