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For additional presentations and related event materials, visit: http://spring-nutrition.org/agngleee-asia
MICRONUTRIENT DEFICIENCIES
&
FOOD FORTIFICATION

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Director, Singapore
GAIN
Micronutrient Malnutrition: Deficiencies in essential vitamins and minerals required in small amounts by the body including:

- Iron
- Vitamin A
- Iodine
- Zinc
- Folic Acid

Deficiencies caused by:

- Insufficient, poor or unvaried diets
- Losses or poor absorption (due to infections like HIV/AIDS, malaria, diarrhea and parasites)
The Global Burden of Vitamin and Mineral Deficiencies (VMD)

- Worldwide, >2 billion people affected
  - Iron: >2 Billion
  - Vitamin A: > 200 million
- VMD = 7.3% of the Global Burden of Disease
- 1.6 million deaths attributed to iron and vitamin A deficiencies alone
- GDP loss 2-3%

Impact of VMD

Individuals

Society

National Development
Numbers not encouraging

58 million people have inadequate iodine intakes and global progress may be slowing\(^1\)

27% of children worldwide are stunted\(^3\)

300 thousand newborns are born with neural tube defects annually\(^4\)

190 million pre-school age children and over 19 million pregnant women are affected by VAD\(^5\)

Global hidden hunger map

Global Hidden Hunger:
Worldwide, approximately 2 billion people are affected by Hidden Hunger.

Hidden Hunger refers to a lack or loss of dietary quality that leaves individuals or populations with deficiencies in essential micronutrients which negatively impact on health, cognition, function, survival, and economic potential.

Severity of Hidden Hunger was determined based on the proportion of under-fives affected by anemia, vitamin A deficiency, stunting as an indicator of zinc deficiency and school-aged children affected by goiter.

UNICEF State of the World’s Children 2009, WHO Global database on vitamin A deficiency and anemia, iodine deficiency
Key micronutrients before and during 1,000 days are crucial for lifelong potential

**Iodine**
- Needed for fetal brain development and IQ, WHO states ID as most common preventable cause of early childhood mental deficiency
- Reduces risk of miscarriage and stillbirth

**Folic acid**
- Adequate pre-pregnancy folate levels reduce incidence of spina bifida by 41% and reduce perinatal mortality due to NTDs by 66%

**Iron**
- Reduces pregnancy complications, perinatal and maternal mortality related to iron deficiency anemia (hemorrhage)
- Can reduce anemia in <24 months by up to 62%

**Zinc**
- Supplementation improves immune function, reduces incidence of diarrhea and pneumonia - more LSFF research needed

**Vitamin A**
- Needed before and during pregnancy to boost maternal vit A levels, immune system, and iron intake
- Intake through breast milk can improve Vitamin A status of nursing infants and lower mortality by 11%
- 40% reduction in vitamin A deficiency among 1-3 year olds

Nutrition interventions
- LSFF
- Targeted interventions (e.g., supplementation)
- School feeding
VMDs - Important Health Problem

Only clinical manifestations visible

Invisible problem under the surface

VMDs remain an underestimated problem!
Strategies addressing the problem of VMD

- Supplementation
- Dietary diversification, other food based approaches (biofortification)
- Public health measures
- Food fortification
Fortification: solution to improve the quality of foods

Addressing wide-spread deficiencies in vitamins and minerals by enriching commonly consumed and accessible foods in a cost efficient way

*Photo*: Fortified Food Products of GAIN and Partnership Programs
Fortification Process

• Fortification can be done at several points:
  ➢ Processing
  ➢ Packaging
  ➢ Consumption

• Fortification can be done with one or multiple vitamins and minerals
## History of Food Fortification: Not a New Idea

<table>
<thead>
<tr>
<th>Micronutrient</th>
<th>Country, Year</th>
<th>Food Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iodine</td>
<td>Switzerland, 1923</td>
<td>Salt</td>
</tr>
<tr>
<td>USA, 1930</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Denmark, 1930</td>
<td>Margarine</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>USA and UK, 1923</td>
<td>Milk</td>
</tr>
<tr>
<td>Iron, B1, B2, Niacin</td>
<td>Canada, 1933</td>
<td>Wheat flour</td>
</tr>
<tr>
<td>USA, 1941</td>
<td></td>
<td></td>
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<tr>
<td>Chile, 1954</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin A</td>
<td>Central America, 1974</td>
<td>Sugar</td>
</tr>
</tbody>
</table>
Fortification History

- In 1920s – 50s: Elimination of multiple nutrient deficiencies, e.g. B-vitamin deficiencies in USA, Canada.
- In 1940s – 50s: Elimination of multiple nutrient deficiencies, e.g. B-vitamin deficiencies in USA, Canada.
- In 1960-90s: Early industry voluntary fortification.
- In 2000s: Emphasis on effectiveness to show health impacts, with high cost-benefit ratio (MDGs, Copenhagen Consensus).

Early 1920s programs – Elimination of single endemic nutrient deficiency, ex. Goiter in Switzerland.

In 1960-90s: Early industry voluntary fortification.
Large Scale Food Fortification: part of a multi-intervention approach to address malnutrition

Large scale food fortification - adding trace amounts of micronutrients to staple foods - is scalable, sustainable, and very cost-effective public health strategy to deliver up to 30% EAR\(^1\) on a daily basis.

Copenhagen Consensus: Fortification ranked among top three international development priorities in 2004, 2008, and 2012, with cost-benefit ratio of **200 to 1**.

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Model Mix Over Time

Market Segment

TIME

Demand Creation, Enabling Environment

Voluntary

Fortified

Targeted Fortified Products

Unfortified

Targeted Fortification

Mass Fortification

LAW

Mandatory

www.gainhealth.org
Current food prices are at an all time high exceeding even the 2008 food crisis levels.

Source: FAO 2011
Food choices and economic status

- **Very, very poor**
  - Rice

- **Very poor**
  - Rice

- **Moderate poor**
  - Rice

- **Less poor**
  - Rice

- **Not poor**
  - Rice
  - Rice and vegs
  - Rice, vegs, and eggs
  - Rice, vegs, eggs, meat
Asia – poverty and dietary diversity

Two recent articles in South Asia showed the link between dietary diversity and nutritional status among children and women:

JH Rah, *Low dietary diversity is a predictor of child stunting in rural Bangladesh*, European Journal of Clinical Nutrition, 2010


Reduced dietary diversity is a strong predictor of stunting in rural Bangladesh.

In India, the study revealed inadequate dietary intake, especially micronutrient deficiency during pregnancy and lactation.

Fortification is crucial to prevent severe micronutrient deficiencies in populations already at risk (low diversity before any crisis)
Dietary quality
Kiess et al, Mal J Nutr 2000

- Economic Crisis
  - ↓ Purchasing power
  - ↓ Intake expensive foods – meat, eggs
    - ↑ Micronutrient deficiencies
  - ↓ Caloric intake (cereals, oil)
    - ↑ Undernutrition

www.gainhealth.org
In crisis context, fortification is even more crucial.

Households are spending 2/3 of their income on food.

In an effort to satisfy energy needs, poor populations may have chosen diets of lesser quality and variety, which would increase the risk of multiple micronutrient deficiencies.

Source: WFP

West, *Vitamin A intake and status in populations facing economic stress*, Journal of Nutrition, 2010
Food Fortification:
Selection of Food Vehicles

- **STAPLE FOODS AND CONDIMENTS**
  - wheat/maize flour, oils, fats, sugar, salt

- **BASIC FOOD PRODUCTS**
  - breads, biscuits, breakfast cereal, dairy products

- **VALUE ADDED FOODS**
  - beverages, convenience foods, candies
Multiple fortified products for different lifecycle stages

- Staple foods and condiments
- Products business led
- MNP
- YYB
- FCF
- LNS
- RUTF

Large Scale approach
Mixed approach
Targeted approach

Possible targets and distribution channels

www.gainhealth.org
Fortification does have an impact

Fish Sauce in Cambodia

Both iron-fortified fish sauces increased haemoglobin and serum ferritin concentrations significantly as compared to placebo.

Rice in India

Iron deficiency anaemia decreased from 30% to 15% in the iron group but remained virtually unchanged in the control group (28% and 27%).

Vegetable oil in Brazil

The study demonstrated that soybean oil with vitamin A in the form of retinal palmitate is well absorbed in humans given fortified oil along with a rice-based diet. Significant increases in plasma retinol were reported.
Anemia and ID are significantly decreased by NaFeEDTA fortified fish sauce.

Critical Programmatic Decisions

► Choice of food vehicle
  • Consumption level of vehicle
  • Appropriate technology
  • Cost-effectiveness (industry concentration)

► Choosing the right premix formula
  • Micronutrient needs of population
  • Bioavailability of fortificant with diet
  • Cost

Guidelines on Food Fortification
WHO/FAO Guidelines on Food Fortification

► Published in 2006 after consultative process
► A practical handbook for implementing fortification projects
► Contains global recommendations for premix specifications for various fortified foods.
► Advice on:
  • Setting programmatic goals and objectives
  • Development of communication and SM
  • Development of legislation, policies and QA/QC protocols
  • Monitoring and evaluating program effectiveness
  • Estimating program cost-effectiveness
Challenges during implementation

• New WHO recommendations

• Government reluctant to change the previous national standards:
  • **Price related:** It will approximately cost every year an additional 1.5 million USD to the Egyptian government to continue fortifying baladi bread with the new guidelines
  • **Process related:** the standards have been included in the law instead of the decree and the process is much longer
  • **Lack of trust:** Previously, consultants were advocating for a different type of compound or premix
Challenges during implementation

• Mandatory legislation in place with no adequate enforcement:
  • Lack of certified national and regional labs to implement proper quality control
  • Irregularities not enough sanctioned and/or not at a sufficient level (fines representing less than the cost of fortification)

• No real integrated national fortification strategy
  • Countries fortifying three commodities with high level of vitamin A
  • Countries promoting fortification of staples not widely consumed
Conclusion

- Vitamin and Mineral Deficiencies (VMDs) take a huge toll on health and economic development globally
- Developing countries have a high burden of VMDs
- Food fortification is one solution and is cost-effective
- Key elements are essential for program success
- Targeted fortification is necessary to reach certain population groups
Core Message

- Vitamin and Mineral Deficiencies (VMDs) take a huge toll on health and economic development globally.

- Developing countries, particularly Asia, have the highest burden of VMDs.

- Solutions to the problem exist and are cost-effective.

- Fortification needs to follow WHO guidelines.

- More consumption data is needed.
THANK YOU
Micronutrient Deficits Are Still Public Health Issues among Women and Young Children in Vietnam

Arnaud Laillou¹, Thuy Van Pham², Nga Thuy Tran², Hop Thi Le², Frank Wieringa³, Fabian Rohner¹, Sonia Fortin³, Mai Bach Le², Do Thanh Tran², Regina Moench-Pfanner¹, Jacques Berger³

Figure 1. Prevalence of micronutrient deficiencies among young children by age groups (in %). ID: iron deficiency; IDA: iron deficiency anemia, ZnD: zinc deficiency, VAD: vitamin A deficiency; mo: months.
doi:10.1371/journal.pone.0034906.g001
Young children

An Assessment of the Impact of Fortification of Staples and Condiments on Micronutrient Intake in Young Vietnamese Children

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Women in reproductive Age

Improvement of the Vietnamese Diet for Women of Reproductive Age by Micronutrient Fortification of Staples Foods and Condiments

Arnaud Laillou¹*, Jacques Berger⁴, Bach Mai Le², Van Thuy Pham², Thi Hop Le², Cong Khan Nguyen³, Dora Panagides¹, Fabian Rohner¹, Frank Wieringa⁴, Regina Moench-Pfanner¹