GLOBAL NUTRITION: CAN WE MAKE A DIFFERENCE?

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Green Templeton College Lecture Series, 11 February 2013
NUTRITION AS A GLOBAL CHALLENGE
Nutrition as a global challenge

- What is the nature and magnitude of global undernutrition?
- Research Studies
- Future challenges and opportunities
John Conrad Waterlow FRS

b: 13th June 1916, d: 19th October 2010

Professor of Human Nutrition,
London School of Hygiene and Tropical Medicine, 1970-1982
Today, roughly 2.5 billion people are either under-nourished (starving) or over-nourished (obese). More than 1 in 3 people are in danger of dying from nutrition-related diseases.

Ellis Rubinstein, President and CEO, The New York Academy of Sciences.
The Hungry People in Our World

Proportion of undernourished people in the world. With reference to Food and Agriculture Organization FAO, 2010
The number of hungry people in the world has been escalating, especially in the recent years. With reference to 2012 World Hunger and Poverty Facts and Statistics.
Under-nutrition

- 925 million people in the world are undernourished
- One in seven people do not get enough food to be healthy and lead an active life
- Malnutrition accounts for 11% of the global burden of diseases, and is the greatest risk to health worldwide

Ellis Rubinstein, President and CEO, The New York Academy of Sciences with reference to World Food Programme
Under-nutrition

- About 6 million children die of starvation each year - that’s as if 1/10 of the UK population were to die annually from something totally preventable!

Ellis Rubinstein, President and CEO, The New York Academy of Sciences, with reference to World Health Organization
Under-nutrition

- Malnutrition kills 3.5 million children under aged 5 each year
- 40% of 11 million deaths of children under 5 are in developing countries
- 50,000 women die during or soon after childbirth
- 19 million infants are born with impaired mental capacity
- 100,000 infants are born with preventable physical defects
- Lack of immediate and exclusive breastfeeding in infancy further add 1.5 million deaths

With reference to 2012 World Hunger and Poverty Facts and Statistics; Global Alliance for Improved Nutrition (GAIN)
Under-nutrition

- The global cost of malnutrition annually is US$ 19 billion lost in adult work performance and related health expenditure.
- Countries may lose 2-3% of GDP due to deficiencies in iron, iodine, and zinc.
- Without addressing malnutrition, the world community may not be able to achieve the Millennium Development Goals (MDGs) in relation to health, hunger, and poverty.

With reference to 2012 World Hunger and Poverty Facts and Statistics; Global Alliance for Improved Nutrition (GAIN)
Over-nutrition

- Worldwide obesity has more than doubled since 1980
- In 2008, more than 1.4 billion adults, 20 and older, were overweight
- Beyond the 1.4 billion adults, more than 40 million children under the age of 5 were overweight in 2010

Ellis Rubinstein, President and CEO, The New York Academy of Sciences, with reference to World Health Organization
The Four Major Nutritional Deficiencies:

- **Protein-energy malnutrition (PEM)**
  - 1 in 4 children world-wide†

- **Vitamin A deficiency (VAD)**
  - 100-140 million children world-wide†

- **Iron deficiency**
  - 4-5 billion world-wide†

- **Iodine deficiency**
  - 2.2 billion world-wide‡

†WHO estimates; ‡ICCIDD estimate
Two Extremes of Protein-Energy Malnutrition (PEM)

Kwashiorkor

Marasmus
Clinical symptoms that are characteristic of kwashiorkor

- Oedema
- Low serum albumin
- Skin de-pigmentation
- Hair de-pigmentation
- Fatty liver
- “Moon face”
Kwashiorkor
Foot of Child with Kwashiorkor
Marasmic Child (After 6 months)
Stages in the Treatment of Malnutrition

- **Phase 1** - treatment of acute complications (normalising fluid and electrolyte disturbances)

- **Phase 2** - initiation of cure (low-calorie and protein intake to prime growth)

- **Phase 3** - rehabilitation (catch-up growth)

Feed for Phase 2 (Initiation of Cure)

**Composition**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>g/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dried skimmed milk powder</td>
<td>17</td>
</tr>
<tr>
<td>Sugar</td>
<td>90</td>
</tr>
<tr>
<td>Oil</td>
<td>30</td>
</tr>
</tbody>
</table>

Provides approximately 700 kcal and 6 g protein/l

**Amounts**

<table>
<thead>
<tr>
<th></th>
<th>Day 2 (approx)</th>
<th>Days 3-7 (approx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of feeds/day</td>
<td>12</td>
<td>8 → 6</td>
</tr>
<tr>
<td>Volume of feed, ml/kg body weight</td>
<td>10</td>
<td>15 → 20</td>
</tr>
<tr>
<td>Total volume, ml/kg/day</td>
<td>120</td>
<td>120</td>
</tr>
</tbody>
</table>

These volumes may be increased a little if there is dehydration and decreased if there is oedema

120 ml/kg provides approximately 85 kcal and 0.7 g protein/kg

Composition of Feeds for Use during Phase 3 (Rehabilitation)

A. **Estimated requirement for catch-up growth at the rate of 20 g weight gain/kg/day**
   - Energy: 175 kcal
   - Protein: 5.75 g/kg/day

B. **Composition of feed**
   - Dried skimmed milk (35% protein): 110 g/l = 38.5 g protein/l
   - Sugar: 50 g/l
   - Oil: 60 g/l
   - Total energy: 1180 kcal/l

Catch-up growth of a child on a high energy diet; expected weight for height 8.70 kg. Reproduced by permission from Waterlow et al. (1978).
Issues

- Requires portable water
- Frequent feeding
- Hospital setting
- Requires manpower support
- Andre Briend
Phase 3 - Rehabilitation

- The catch-up growth period is the longest and may take up to 5-6 weeks

- In order to avoid the problems associated with the use of unclean water in the formulation of the liquid solution, a few years ago a French company, Nutriset, developed a product called “Plumpy’nut®”

- These products are commonly called “ready-to-use therapeutic foods” (RUTF)

RUTF Formulation (Plumpy’nut®)

- Peanut butter 250 g
- Oil 150 g
- Full cream milk powder 300 g
- Icing sugar 280 g
- Vitamin/mineral premix 20 g
- Total 1 kg

Cost implications? Local production

Plumpy’nut® Physicochemical Structure
(from publicity literature)

- **Form:** paste
- **Taste & smell:** typical of peanut
- **Humidity:** < 5%
- **Total fat:** 57% in energy input
- **Protein:** 11% in energy input
- **Total energy:** 530 kcal per 100 g
- **Aflatoxins:** < 5 μg/kg or 5 ppb/kg (European standards) but may reach 20 ppb (American standards). Check the standards applicable in the country concerned.

Issues with RUTF Products containing Peanuts/ Milk Powder

- Peanuts - problems related to mycotoxins - QC
- Peanuts (protein) - potential to cause allergic reaction (a major issue in developed countries)
- Milk powder still remains a relatively expensive commodity

Issues with RUTF Products containing Peanuts/ Milk Powder

Question:

☐ Can we completely replace peanuts and milk powder from the formulation and produce a product of high nutritional quality, taste and shelf-life?

Attributes of an Ideal RUTF Formulation

- Good nutritional quality (i.e. protein, energy and micronutrient content)
- Long shelf-life
- Highly palatable
- A consistency suitable for feeding infants/children
- Requires no additional processing prior to feeding

Examples of trial formulations:

<table>
<thead>
<tr>
<th></th>
<th>Energy per 100 g</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(kcal/100 g)</td>
<td>Protein</td>
</tr>
<tr>
<td>Brown chick peas (<em>Cicer arietinum</em>) and wheat (<em>Triticum spp.</em>)</td>
<td>507</td>
<td>9.2</td>
</tr>
<tr>
<td>Lentils (<em>Lens culinaris</em>) and barley (<em>Hordeum vulgare</em>)</td>
<td>520</td>
<td>9.7</td>
</tr>
<tr>
<td>Split peas (<em>Pisum sativum</em>) and wheat (<em>Triticum spp.</em>)</td>
<td>523</td>
<td>8.9</td>
</tr>
<tr>
<td>Soybean (<em>Glycine max</em>), and maize (<em>Zea mays</em>)</td>
<td>522</td>
<td>12.2</td>
</tr>
</tbody>
</table>

All cereals and legumes were roasted. Appropriate proportion of sugar, oil and vitamins and minerals were added.

Various RUTF Formulations Showing Textural and Colour Differences

Example of RUTF Gross Composition Compared to Plumpy’nut®

<table>
<thead>
<tr>
<th></th>
<th>RUTF (100 g)</th>
<th>% energy</th>
<th>Plumpy’nut® (100 g)</th>
<th>% energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal)</td>
<td>512</td>
<td></td>
<td>530*</td>
<td></td>
</tr>
<tr>
<td>Energy (kJ)</td>
<td>2142</td>
<td></td>
<td>2218</td>
<td></td>
</tr>
<tr>
<td>Protein (g)</td>
<td>13.4</td>
<td>10.5</td>
<td>14.5</td>
<td>11.0*</td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td>50.2</td>
<td>39.2</td>
<td>43.0</td>
<td>32.0</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>28.6</td>
<td>50.3</td>
<td>33.5</td>
<td>57.0*</td>
</tr>
<tr>
<td>Ash (g)</td>
<td>4.9</td>
<td></td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>Moisture (g)</td>
<td>2.9</td>
<td></td>
<td>&lt; 5.0</td>
<td></td>
</tr>
</tbody>
</table>

*Values from Nutriset

A NOVEL FORTIFIED BLENDED FLOUR, CORN-SOY BLEND “PLUS-PLUS”, IS NOT INFERIOR TO LIPID-BASED READY-TO-USE SUPPLEMENTARY FOODS FOR THE TREATMENT OF MODERATE ACUTE MALNUTRITION IN MALAWIAN CHILDREN

TREATMENT OF MODERATE ACUTE MALNUTRITION WITH READY-TO-USE SUPPLEMENTARY FOOD RESULTS IN HIGHER OVERALL RECOVERY RATES COMPARED WITH A CORN-SOYA BLEND IN CHILDREN IN SOUTHERN ETHIOPIA: AN OPERATIONS RESEARCH TRIAL

RANDOMIZED CONTROLLED TRIAL OF THE EFFECTIVENESS OF A SOYBEAN-MAIZE-SORGHUM–BASED READY-TO-USE COMPLEMENTARY FOOD PASTE ON INFANT GROWTH IN SOUTH KIVU, DEMOCRATIC REPUBLIC OF CONGO

Nutritional Deficiencies

- 3 of the 4 major nutritional problems are micronutrient-based!
  - Vitamin A deficiency
    - 600-700 µg/day*
  - Iron deficiency
    - 8.7-14.8 mg/day*
  - Iodine deficiency
    - 140 µg/day*

* Reference Nutrient Intake for adults (19-50 years)
Vitamin A Deficiency

- Is common in developing countries.
- Associated with blindness, measles, diarrhoea, pneumonia, malaria, anaemia in children.
- Can occur through deficient vitamin A intake, fat intake, chronic diarrhoea (fat malabsorption), parasitic load, excess alcohol intake.
- Functional Vitamin A deficiency can also occur as a result of PEM due to deficiency of plasma retinol-binding protein (RBP).
Vitamin A and Its Role in Nutrition
Children and Vitamin A Deficiency

- VAD blindness in children under age five years
  - 2.8 million cases

- VAD children becoming blind each year
  - 250,000–500,000

- VAD children
  - 23% more likely to die
  - 50% more likely to suffer acute measles

- VAD is a major cause of increased maternal mortality and a main contributor to poor pregnancy and lactation outcomes
Prevalence of Vitamin A Deficiency in Children Under 5 years
Grades of Mild Xerophthalmia

Night blindness (XN)

Conjunctival xerosis (X1A)

Bitot’s spot (X1B)

Corneal xerosis (X2)
Grades of Severe Xerophthalmia

Corneal ulceration: < 1/3 cornea (X3A)

Corneal ulceration: ≥ 1/3 cornea (X3B)

Corneal scarring: XS
Infant and Vitamin A Deficiency

- Amongst women it is likely to be associated with high mortality related to pregnancy
- Babies are born with no liver stores, so no buffer
- Importance of Vitamin A intake through breast milk
Prophylaxis- Preserving Health

- **Treatment:**
  20,000ug retinol palmitate/d for 2 days by mouth or intramuscular in water-based preparations

- **Prevention**
  66,000ug retinol palmitate once / 3 to 6 months for children 1 to 4 years, half below 1

- The World Bank has long noted that is one of the most cost-effective health interventions in existence.
Vitamin A Supplementation
Vitamin A Supplementation

- Periodic, high-dose vitamin A supplementation is one of the most widely practised direct means to prevent deficiencies by governments throughout the world.

Is it really effective??
Why are we still Vitamin A Deficient when surrounded by dark, green leafy fruits and vegetables?
Carotenoids

- More than 700 carotenoids identified to date.
- About 40 carotenoids are found in our foods.
- As a result of selective uptake in the digestive tract, less than 20 carotenoids with some of their metabolites have been detected in human plasma and tissues.
Absorption of Vitamin A from Plant Sources

β-Carotene → Retinol

1/12
Provitamin A Content in Plants and Fruits

Relative dietary vitamin A activity of red palm oil and other sources of provitamin A carotenes

<table>
<thead>
<tr>
<th>Source</th>
<th>Retinol Equivalents</th>
<th>Retinol Activity Equivalents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RE#/100 g (edible portion)</td>
<td>Relative Activity#</td>
</tr>
<tr>
<td>Crude palm oil</td>
<td>6140</td>
<td>1</td>
</tr>
<tr>
<td>Carrots</td>
<td>2000</td>
<td>3</td>
</tr>
<tr>
<td>Leafy vegetables</td>
<td>685</td>
<td>9</td>
</tr>
<tr>
<td>Apricots</td>
<td>250</td>
<td>24</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>100</td>
<td>61</td>
</tr>
<tr>
<td>Bananas</td>
<td>30</td>
<td>205</td>
</tr>
<tr>
<td>Oranges or orange juice</td>
<td>8</td>
<td>768</td>
</tr>
</tbody>
</table>

Modified after Scrimshaw. # The data for RE have been recalculated and corrected for what the original author had presented in his 2000 review paper. It is assumed here that crude palm oil has 500 ppm (50 mg/100 g).

COMPARISON OF THE EFFECTS OF SUPPLEMENTAL RED PALM OIL AND SUNFLOWER OIL ON MATERNAL VITAMIN A STATUS

Singida: Where We did Our Study on Vitamin A Deficiency
Characteristics of the Study Subjects

<table>
<thead>
<tr>
<th>Characteristics of the study subjects(^1)</th>
<th>Red palm oil group</th>
<th>Sunflower oil group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age of mother (y)</strong></td>
<td>30.2 ± 1.4 [27]</td>
<td>27.2 ± 1.1 [29]</td>
<td>26.4 ± 1.3 [27]</td>
</tr>
<tr>
<td><strong>Parity</strong></td>
<td>4.5 ± 0.5 [27]</td>
<td>3.5 ± 0.4 [29]</td>
<td>3.2 ± 0.4 [27]</td>
</tr>
<tr>
<td><strong>Time between pregnancies (y)</strong></td>
<td>2.1 ± 0.1 [21]</td>
<td>1.8 ± 0.2 [22]</td>
<td>1.9 ± 0.2 [16]</td>
</tr>
<tr>
<td><strong>Height (cm)</strong></td>
<td>160.4 ± 1.3 [28]</td>
<td>159.1 ± 1.2 [29]</td>
<td>159.1 ± 1.1 [28]</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Third trimester</strong></td>
<td>60.1 ± 1.5 [27]</td>
<td>60.1 ± 1.5 [28]</td>
<td>57.4 ± 1.3 [26]</td>
</tr>
<tr>
<td><strong>1 mo postpartum</strong></td>
<td>56.7 ± 1.6 [27]</td>
<td>56.3 ± 1.4 [29]</td>
<td>53.2 ± 1.2 [26]</td>
</tr>
<tr>
<td><strong>3 mo postpartum</strong></td>
<td>56.8 ± 1.7 [26]</td>
<td>56.0 ± 1.6 [27]</td>
<td>52.4 ± 1.3 [27]</td>
</tr>
<tr>
<td><strong>Hemoglobin (g/L)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Third trimester</strong></td>
<td>120 ± 2.0 [27]</td>
<td>109 ± 2.8(^2) [28]</td>
<td>121 ± 2.0 [26]</td>
</tr>
<tr>
<td><strong>1 mo postpartum</strong></td>
<td>135 ± 2.6 [27]</td>
<td>138 ± 2.4 [29]</td>
<td>135 ± 2.3 [26]</td>
</tr>
<tr>
<td><strong>3 mo postpartum</strong></td>
<td>134 ± 2.2 [26]</td>
<td>134 ± 1.5 [27]</td>
<td>134 ± 1.5 [27]</td>
</tr>
</tbody>
</table>

\(^{1}\bar{x} \pm \text{SEM}; \ n \text{ in brackets.}\)

\(^{2}\)Significantly different from control group, \(P < 0.01\) (Dunnett’s two-sided t test).

# Comparison of Carotenoid Content between Red Palm Oil and Sunflower Oil

<table>
<thead>
<tr>
<th>Daily consumption of carotenoids from red palm oil and sunflower oil</th>
<th>Red palm oil$^1$</th>
<th>Sunflower oil$^{1,2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mcg/d (% )</td>
<td>µg/d (%)</td>
<td>µg/d (%)</td>
</tr>
<tr>
<td><strong>Lutein</strong></td>
<td>12 ± 6.0$^3$ (0.4)</td>
<td>5.4 ± 0.7 (50.0)</td>
</tr>
<tr>
<td><strong>Zeaxanthin</strong></td>
<td>9 ± 4.6 (0.3)</td>
<td>5.4 ± 0.7 (50.0)</td>
</tr>
<tr>
<td><strong>β-Cryptoxanthin</strong></td>
<td>9 ± 2.1 (0.3)</td>
<td>0.0 (0.0)</td>
</tr>
<tr>
<td><strong>Lycopene</strong></td>
<td>38 ± 19.1 (1.1)</td>
<td>0.0 (0.0)</td>
</tr>
<tr>
<td><strong>all-trans-α-Carotene</strong></td>
<td>909 ± 17.8 (26.0)</td>
<td>0.0 (0.0)</td>
</tr>
<tr>
<td><strong>cis-α-Carotene$^4$</strong></td>
<td>389.1 ± 1.5 (11.1)</td>
<td>0.0 (0.0)</td>
</tr>
<tr>
<td><strong>all-trans-β-Carotene</strong></td>
<td>1114 ± 10.7 (31.9)</td>
<td>0.0 (0.0)</td>
</tr>
<tr>
<td><strong>cis-β-Carotene$^5$</strong></td>
<td>1012.8 ± 9.1 (29.0)</td>
<td>0.0 (0.0)</td>
</tr>
<tr>
<td><strong>Total provitamin A</strong></td>
<td>2034 (57.9)</td>
<td>0.0 (0.0)</td>
</tr>
<tr>
<td><em>(trans isomers)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total carotenoids</strong></td>
<td>3496 (100.0)</td>
<td>10.2 (100.0)</td>
</tr>
</tbody>
</table>

1 Calculated amount in 4 plastic tablespoons of oil (12 g).  
2 Mean concentration of 6 samples analyzed in duplicate.  
3 X ± SD.  
4 Concentration calculated by using the extinction coefficient of *all*-trans-α-carotene.  
5 Concentration calculated by using the extinction coefficient of *all*-trans-β-carotene.

Boxplot Summary of Breast-milk Retinol Concentrations at 1 and 3 mo postpartum

Figure 1. Boxplot summary of breast-milk retinol concentrations 1 mo postpartum.

Figure 2. Boxplot summary of breast-milk retinol concentrations 3 mo postpartum.

Goitre

Grade 1

Enlarged grade 2 non-nodular goitre

Moderately enlarged diffuse goitre

Large asymmetrical goitre
Earliest example of Food Fortification is Fortification of wheat flour from the 1940’s with Iron, Calcium, Thiamine and niacin
Food Fortification Intervention

- The World Bank concurs on the importance of food fortification:

  “The control of vitamin and mineral deficiencies is one of the most extraordinary scientific advances of recent years to improve lives and accelerate development at such low cost and in such a short time”
Types of Food Fortification

- Staple food fortification, especially for wheat, rice specifically in Asia Pacific, and sugar
- Targeted supplementation programs with micronutrient powders, fortified blended foods or nutritional supplements
- Cooperation with local industries and health authorities to support the development and marketing of locally produced products that:
  - Are nutritional and affordable for people with low incomes
  - Improve the nutrition of pregnant and lactating mothers and their babies

With reference to Global Alliance for Improved Nutrition (GAIN)
Salt Fortification Plant
Examples of Fortified Staples

Food fortification

Fortified sugar

Iodized salt
Other Fortified Foods Include

- Foods that have been fortified include:
  - Margarine – vitamin A & E
  - Wheat flour/maize flour – noted previously
  - Sugar – vitamin A
  - Salt – iodine, iron
  - Tea – iron
  - MSG – vitamin A
  - Soy sauce – iron
  - Curry powder – iron
  - Breakfast cereals – B1, B2, Niacin, B6, B12, Folic acid, iron
Globally approximately 10 Million Refugees. Historically

- Refugee rations mainly composed of
  - 400 grams Cereal
  - 30 grams of legume
  - 20 grams oil
  - 5 grams sugar
Between 1989 and 1990 a severe outbreak of pellagra occurred amongst Mozambican refugees in Malawi.
Niacin (B3) Deficiency: Child with Pellagra
# Nutrition in Refugee Rations

## COMPARISON OF VITAMIN AND IRON CONTENT IN REFUGEE RATIONS* AND PET FOOD†

<table>
<thead>
<tr>
<th>Food item</th>
<th>Quantity (g)</th>
<th>Thiamine (mg)</th>
<th>Riboflavin (mg)</th>
<th>Niacin (mg)</th>
<th>Folic acid (µg)</th>
<th>Vitamin C (mg)</th>
<th>Vitamin A (µg)</th>
<th>Iron (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Refugee ration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat flour</td>
<td>400</td>
<td>1.28</td>
<td>0.08</td>
<td>8.0</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>6.8</td>
</tr>
<tr>
<td>Kidney beans</td>
<td>30</td>
<td>0.16</td>
<td>0.05</td>
<td>1.6</td>
<td>39</td>
<td>0</td>
<td>0</td>
<td>2.0</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sugar</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>455</td>
<td>1.44</td>
<td>0.13</td>
<td>9.6</td>
<td>79</td>
<td>0</td>
<td>0</td>
<td>8.8</td>
</tr>
<tr>
<td><strong>Pet food‡</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>455</td>
<td>1.07</td>
<td>1.62</td>
<td>22.5</td>
<td>52</td>
<td>0</td>
<td>1090</td>
<td>44</td>
</tr>
<tr>
<td><strong>RNI§</strong></td>
<td></td>
<td>1.1</td>
<td>1.3</td>
<td>17</td>
<td>200</td>
<td>40</td>
<td>700</td>
<td>14.8</td>
</tr>
</tbody>
</table>

*Based on food consumption tables; †typical analytical values; ‡comparable quantity (on a dry weight basis; §reference nutrient intake per day (values for adult 19–50 yr). Dietary reference values for food, energy, and nutrients for the UK (Report on Health and Social Subjects no 41, London: HM Stationery Office, 1991)

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THE MICRONUTRIENT FORTIFICATION OF REFUGEE RATIONS TO PREVENT NUTRITIONAL DEFICIENCIES IN REFUGEE DIETS

South Asia has the Highest Number of Low Birthrate Infants

With reference to UNICEF, 2001
South Asia has the Highest Number of Low Birthrate Infants

With reference to UNICEF, 2001
Cycle of Malnutrition

Household food insecurity

POVERTY

Malnourished mothers

LBW (Low Birth Weight)

Malnourished girls

Inadequate MCH CARE

Maternal malnutrition perpetuates intergenerational malnutrition
David Barker’s hypothesis on fetal origins of adult disease
DIABETES : TOP 3 COUNTRIES IN THE WORLD IN 2010

Conclusion

- Global burden of malnutrition still remains high notably in protein energy malnutrition and micronutrient deficiency
- Undernutrition a major cause of increased morbidity and mortality
- 80 % undernutrition is clustered in 30 odd countries
- Whilst progress has been made in many areas to eradicate under nutrition, several challenges remain
Challenges

- Lack of global leadership in nutrition
- Lack of awareness of the magnitude of undernutrition amongst thought leaders
- Dichotomy of needs assessment: Treatment vs. prevention
- Weak linkages between trade, agriculture and development
- Private public partnership viewed with scepticism
Can we afford it?

Cost of supplying basic education to all children
Spent on cosmetics in just the USA

$6 billion per year
$8 billion

Cost of supplying water and sanitation for all
Spent on ice cream in Europe alone

$9 billion per year
$11 billion

Cost of basic health for all
Spent on pet food in Europe and USA

$13 billion per year
$17 billion

Cost of eliminating malnutrition in emerging countries through improved agriculture

$40 billion per year

Spent on countering over-nutrition in West through slimming aids

$40 billion

Nutrition is a discipline that has international relevance and can improve the lives of millions