Micronutrients, Health and Development:
Evidence-based Programs

12-15 MAY 2009  BEIJING, CHINA
Micronutrients, Health and Development:
Evidence-based Programs

12–15 May 2009  • Beijing, China

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Welcome

WELCOME FROM YOUR HOSTS
On behalf of the conference organizers and sponsors, welcome to the 2009 biennial meeting of the Micronutrient Forum, “Micronutrients, Health and Development: Evidence-based Programs.”

The Beijing meeting of the Micronutrient Forum is co-hosted by:
- The Micronutrient Forum Program Committee
- The Chinese Center for Disease Control and Prevention (Chinese CDC)

As your official hosts, we are delighted that you are here to participate in this important event. Building on the scientific review of evidence at the 2007 Istanbul meeting of the Micronutrient Forum, this meeting provides an in-depth look at the successes and challenges to micronutrient program implementation. With an eye to the future, this year’s meeting creates an opportunity to highlight “what works” and where further operational and scientific research investments are needed.

Additionally, the meeting provides a great opportunity to network with individuals across various sectors and from around the globe. Take full advantage of this opportunity, but also find time to enjoy the amazing sights Beijing has to offer.

ABOUT THE MICRONUTRIENT FORUM
Since its establishment in 2006, the Micronutrient Forum has played an international role as a catalyst and convener for sharing expertise, insights, and experience relevant to the control of micronutrient deficiencies and their consequences around the globe. The Forum is the successor to two scientific organizations aimed at advancing the control of vitamin A and iron deficiencies: the International Vitamin A Consultative Group (IVACG) and the International Nutritional Anemia Consultative Group (INACG). The Micronutrient Forum focuses primarily on micronutrient deficiencies of public health significance, particularly vitamin A, iron, folate, iodine, and zinc. As with international IVACG and INACG meetings in the past, the Forum encourages innovation, recognizes important research findings, increases awareness of the latest data, and promotes consensus and recognition of important policy implications and programs. The Forum invites leading scientists, policy makers, and programmers to present their latest research and operational findings, and facilitates dialogue among these groups on use of the available evidence in reducing deficiencies of vitamins and minerals.
Sponsors

The Micronutrient Forum Secretariat and the Local Organizing Committee gratefully acknowledge the contributions of the following organizations and companies:

**PLATINUM LEVEL SPONSORS**

**United States Agency for International Development (USAID)**

USAID is an independent federal government agency with headquarters in Washington D.C. and over 80 field offices around the world. USAID furthers U.S. foreign policy objectives by supporting economic growth, agriculture, and trade; global health; and democracy, conflict prevention, and humanitarian assistance. In global health, USAID focuses on improving maternal and child health and nutrition; advancing reproductive health programs; and reducing the burden of infectious diseases. For more information please visit [www.usaid.gov](http://www.usaid.gov).

**Chinese Center for Disease Control and Prevention—Food Fortification Office**

The Food Fortification Office (FFO) is responsible for implementing the national nutrition improvement project under the leadership of the Chinese Center for Disease Control and Prevention (Chinese CDC). The functions of this office include organizing and demonstrating scientific research, implementing national food fortification projects, drafting national food fortification strategy, and improving public health status alongside national economic development. Among its many achievements, since 2003 the FFO was the major executive agent of the Global Alliance for Improved Nutrition (GAIN)-supported "Application of NaFeEDTA Fortified Soy Sauce in the Control of Iron Deficiency in China". It also conducted the national program for fortified flour in Gansu province, implemented an infant’s complementary food fortification project, and carried out a comprehensive nutrition intervention project in schools for migrant workers’ children. For more information please visit [www.cdc-ffo.cn](http://www.cdc-ffo.cn).

**International Life Sciences Institute (ILSI) Focal Point in China**

ILSI Focal Point in China was established in 1993 in close collaboration with the Chinese Academy of Preventive Medicine (currently the Chinese Center for Disease Control and Prevention). The first director was Mme. Chen Chunming, and the current Director is Dr. Junshi Chen. ILSI Focal Point in China serves as a bridge to link government, academia, and industry with scientific communication. ILSI Focal Point in China promotes the exchange of scientific information in nutrition, toxicology, and food and environment safety between Chinese scientists, government regulators, and their international counterparts. For more information please visit [www.china.ilsi.org](http://www.china.ilsi.org).

**U.S. Centers for Disease Control and Prevention**

The Centers for Disease Control and Prevention (CDC) protects people’s health and safety by preventing and controlling diseases and injuries; enhances health decisions by providing credible information on critical health issues; and promotes healthy living through strong partnerships with local, national and international organizations. For more information please visit [www.cdc.gov](http://www.cdc.gov).
SIGHT AND LIFE
A humanitarian initiative for better nutrition, health and wellbeing
SIGHT AND LIFE is a humanitarian initiative of DSM Nutritional Products covering a wide range of activities in cooperation with global and local partners and collaboration with leading universities. To ensure a sustainable and significant improvement in human nutrition and health, SIGHT AND LIFE encourages partnerships and the generation and exchange of scientific information and the formation of networks. For more information please visit www.sightandlife.org.

Amway (China) Co., Limited
Amway (China) Co., Limited (ACCL) is a large-scale, U.S.-invested manufacturing and distribution company with 6,000 employees in various facilities across the country. Nutrilite is the nutrient supplement brand under Amway with 75 years of history. Business aside, ACCL gives back to society generously and implements its corporate social responsibility focusing on health improvement, child care, environmental protection, and volunteer service. ACCL is active in promoting exchange and cooperation between the world’s leading research institutes for nutrition and health, and Chinese institutions. In addition ACCL is also a leader in improving the adoption and application of the latest science and research results in China. For more information please visit www.amway.com.cn and www.nutrilite.com.

GOLD LEVEL SPONSORS

SILVER LEVEL SPONSORS

BRONZE LEVEL SPONSORS
BASF
Practical Information

REGISTRATION DESK
The registration desk is located on the 2nd Floor of the Beijing International Convention Center (BICC). The registration desk will be open each day during the general meeting.

NAME BADGES
You will receive a name badge when you pick up your meeting packet at the registration desk. Please wear your badge throughout the meeting. Your badge serves as your ticket for entrance to all meeting functions.

HOSPITALITY DESK
China Comfort Travel (CCT) will have a designated hospitality desk near the conference registration area. Please stop by for information on dining and shopping in Beijing, for flight reconfirmations, and to confirm arrangements and scheduled times for tours and airport transfers.

MEALS
Coffee and tea will be served during scheduled breaks Tuesday through Friday. Participants are responsible for all other meals. The Beijing International Convention Center and the Continental Grand Hotel both are home to numerous restaurants and coffee shops. There are also a number of neighborhood eateries within easy walking distance of the Forum venue (please refer to the map provided in your meeting bag).

MESSAGE BOARD
Messages for participants will be posted on a message board near the registration area. Please check the board often to see if there is a message for you.

NO SMOKING, PLEASE
Smoking is not permitted in the meeting rooms. We appreciate your cooperation.

TRANSPORTATION
Attendees are responsible for their own transportation to and from the convention center and throughout the city. Taxi cards in Chinese are available from your hotel reception. Show this to your taxi driver when requesting transportation to your hotel.
About the Meeting

MEETING SESSIONS
All of the meeting’s plenary sessions and poster sessions will take place at the Beijing International Convention Center (BICC). Plenary sessions will be in Convention Hall No.1 and poster sessions in Convention Hall No. 2.

QUESTIONS AND COMMENTS
Your questions and comments are welcome during the scheduled discussion periods. If you would like to ask a question or make a comment, please go to one of the microphones located in the aisles. After you are recognized by the session moderator, please identify yourself and state your affiliation or organization before proceeding with your question or comment.

ABSTRACTS
Copies of abstracts of oral and poster presentations are included in this book.

POSTERS
Posters will be on display in Convention Hall #2, located on Level 2 of the Beijing International Convention Center. Posters are arranged according to the numbers listed in this program and grouped by thematic categories. Presenters will be available to discuss their posters and answer questions during the scheduled poster sessions, and posters will also be available for viewing during other breaks. See “Poster Schedule at a Glance” section of this book for schedule and details.

SIGHT AND LIFE YOUNG INVESTIGATORS AWARD
The SIGHT AND LIFE Young Investigators Award recognizes young researchers for undertaking micronutrient research that has scientific, policy, and/or programmatic relevance, and facilitates interactions between young investigators and leading scientists and researchers. Posters from applicants will be posted in Convention Hall #2, located on Level 2 of the Beijing International Convention Center in the area marked “SIGHT AND LIFE Young Investigators Poster Area.” The Selection Committee will review all posters during the extended lunch break on Tuesday, 12 May 2009. The award finalists and winner will be presented during the plenary sessions on Wednesday, 13 May 2009 at 12:40 hours.

EVALUATIONS
We value your opinion about this meeting and will use your comments to improve future Micronutrient Forum meetings! We appreciate your evaluations, suggestions and comments, so please complete the evaluation form in your packet and leave it at the registration desk before 18:00 on Friday, 15 May 2009. Your feedback will help us make the next Micronutrient Forum meeting even better.

AND FINALLY…
We wish you a pleasant stay in Beijing. We hope this meeting will engender challenging discussions, strengthen ties among old and new colleagues alike, and provide you with new information and tools to use in your work.
## Program of the Micronutrient Forum

**Micronutrients, Health and Development: Evidence-based Programs**  
12 to 15 May 2009 — Beijing, China

### PROGRAM AT A GLANCE

#### MONDAY, 11 MAY 2009

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
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<tbody>
<tr>
<td>15:00</td>
<td>Registration</td>
</tr>
<tr>
<td>16:00</td>
<td>Poster Set up</td>
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</table>

#### TUESDAY, 12 MAY 2009

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>8:00</td>
<td>Registration/ Sponsors Exhibits Open</td>
</tr>
<tr>
<td>9:00</td>
<td>Inauguration of the Micronutrient Forum</td>
</tr>
<tr>
<td>9:45</td>
<td>Memorial to Dr. John Beard</td>
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<tr>
<td>10:00</td>
<td>Status of Micronutrient Deficiencies in China</td>
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<tr>
<td>11:00</td>
<td>BREAK</td>
</tr>
<tr>
<td>11:30</td>
<td>Bringing Evidence and Experience to Micronutrient Programs: The 2008 Innocenti Process</td>
</tr>
<tr>
<td>12:40</td>
<td>Maternal Iron-Folic Acid Supplementation: Great Policy, Failed or Forgotten Implementation?</td>
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<tr>
<td>14:00</td>
<td>LUNCH AND POSTER VIEWING</td>
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<tr>
<td>15:05</td>
<td>Vitamin A Supplementation Programs for Children 6-59 Months: Evidence of Implementation and Impact</td>
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<tr>
<td>15:35</td>
<td>BREAK</td>
</tr>
<tr>
<td>15:35</td>
<td>Universal Salt Iodization Programs: Evidence of Implementation and Impact</td>
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<tr>
<td>16:05</td>
<td>Micronutrient Metabolism</td>
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End of Tuesday’s Formal Sessions

#### WEDNESDAY, 13 MAY 2009

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>8:30</td>
<td>Developmental Origins of Health and Disease: Early Micronutrient Exposure</td>
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<tr>
<td>9:00</td>
<td>Scaling-up New Technologies, Evidence of Implementation and Impact: Micronutrient Powders and Spreads</td>
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<tr>
<td>10:00</td>
<td>BREAK, POSTERS, AND EXHIBITS</td>
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<tr>
<td>11:00</td>
<td>BREAK, POSTERS, AND EXHIBITS</td>
</tr>
<tr>
<td>11:45</td>
<td>Break, Exhibits and Poster Viewing</td>
</tr>
<tr>
<td>13:00</td>
<td>LUNCH AND POSTER VIEWING</td>
</tr>
<tr>
<td>15:00</td>
<td>Food Fortification Programs: Evidence of Implementation and Impact</td>
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End of Wednesday’s Formal Sessions

#### THURSDAY, 14 MAY 2009

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>8:30</td>
<td>Micronutrients and Maternal, Newborn and Child Health: New Research Findings</td>
</tr>
<tr>
<td>9:45</td>
<td>BREAK, POSTERS, AND EXHIBITS</td>
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<tr>
<td>10:35</td>
<td>amenities Management and Control</td>
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<tr>
<td>11:00</td>
<td>Status of Micronutrient Deficiencies in China</td>
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<tr>
<td>11:45</td>
<td>Break</td>
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<tr>
<td>12:05</td>
<td>Agricultural-based Programs: Biofortification</td>
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<tr>
<td>12:50</td>
<td>PANEL: Private Sector Strategies for Reducing Micronutrient Malnutrition: Opportunities and Challenges in Reaching the Bottom of the Pyramid</td>
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End of Thursday’s Formal Sessions

#### FRIDAY, 15 MAY 2009

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>12:35</td>
<td>Moving Beyond Coverage: Achieving Sustainability</td>
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<tr>
<td>13:45</td>
<td>Micronutrient Metabolism</td>
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<tr>
<td>14:45</td>
<td>BREAK</td>
</tr>
<tr>
<td>15:15</td>
<td>Evidence-based Impact of Poverty Alleviation Programs: Maximizing Nutritional Benefits</td>
</tr>
<tr>
<td>16:10</td>
<td>Closure</td>
</tr>
<tr>
<td>16:40</td>
<td>End of Micronutrient Forum’s Formal Sessions</td>
</tr>
</tbody>
</table>

19:00  Welcome Reception
MEETING PROGRAM

MONDAY, 11 MAY 2009
15:00  19:00  Registration
16:00  18:30  Poster Set Up

TUESDAY, 12 MAY 2009
8:00  Registration/ Sponsors Exhibits Open

Inauguration of the Micronutrient Forum
9:00  Welcome Message from the Chair of the Micronutrient Forum  
  Dr. Alfred Sommer  
  Dean Emeritus and Professor, Johns Hopkins Bloomberg School of Public Health

9:10  Welcome Message from the Ministry of Health of the People's Republic of China  
  Mr. Xiaohong Chen  
  Vice Minister of Health, P.R.China

9:20  Welcome Message from the United States Government  
  U.S. Government Representative

  Dr. Werner Schultink  
  Chief, Nutrition Section, UNICEF

9:30  Welcome Message from the World Health Organization (WHO)  
  Dr. Francesco Branca  
  Director, Department of Nutrition for Health and Development, WHO

9:35  Welcome Message from the United Nations World Food Program (WFP)  
  Dr. Martin Bloem  
  Chief, Nutrition and HIV Policy Unit, WFP

9:45  Memorial to Dr. John Beard  
  Dr. Sean Lynch

Status of Micronutrient Deficiencies in China
10:00  Status of Micronutrient Deficiencies in China-Overview  
  Prof. Yang Xiaoguang
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter(s)</th>
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<tbody>
<tr>
<td>10:10</td>
<td>Case Study: Iron-fortified Soy Sauce in China</td>
<td>Prof. Chen Junshi</td>
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<tr>
<td>10:20</td>
<td>Birth Defects and Folic Acid Supplementation</td>
<td>Prof. You Weicheng</td>
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<tr>
<td>10:30</td>
<td>Success of Universal Salt Iodization (USI) in China</td>
<td>Prof. Zheng Qingsi</td>
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<tr>
<td>10:40</td>
<td>Case Study: Flour Fortification in China</td>
<td>Prof. Zheng Xiaoying</td>
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<tr>
<td>10:50</td>
<td>Questions and Answers</td>
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<tr>
<td>11:00</td>
<td>Break</td>
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<tr>
<td>11:00</td>
<td>Bringing Evidence and Experience to Micronutrient Programs: The 2008 Innocenti Process</td>
<td>Moderators: Dr. Phil Harvey</td>
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<td>Co-moderator: Mme. Chen Chunming</td>
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<tr>
<td>11:30</td>
<td>Bringing Science to Programs: The 2008 Innocenti Process</td>
<td>Dr. Emorn Wasantwisut</td>
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<tr>
<td>11:45</td>
<td>What Works and How Do We Know What Works: Challenges and Approaches</td>
<td>Dr. David Pelletier</td>
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<tr>
<td>12:10</td>
<td>Linking the 2008 Innocenti Process with the Micronutrient Forum: Evidence-based Programs at Scale</td>
<td>Dr. Rolf Klemm</td>
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<td>Moderator: Ms. Evelyne Guindon</td>
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<td>Director, Resource Development and Partnerships, Micronutrient Initiative</td>
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<tr>
<td>12:40</td>
<td>Lunch and Poster Viewing</td>
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</table>
**Vitamin A Supplementation Programs for Children 6-59 Months: Evidence of Implementation and Impact**

Moderator: Ms. Alison Grieg  
Co-Moderator: Prof. Lin Xu

14:00 TU1* Global Prevalence of Vitamin A Deficiency  
* Dr. Lisa Rogers

14:15 Vitamin A Supplementation Programs for Children 6-59 Months: An Overview and Update  
* Mr. Shawn Baker

14:30 TU2 Reductions in Under-five Mortality Associated with High-coverage Vitamin A Supplementation Programs: Evidence from National Surveys  
* Dr. Amy Rice

14:45 TU3 Measuring the Impact of Vitamin A Programs  
* Dr. Amanda Palmer

14:55 Summary and Conclusion  
* Mr. Shawn Baker

15:05 Break

**Iodine and Universal Salt Iodization**

Moderator: Mr. Venkatesh Mannar  
Co-moderator: Prof. Zheng Qingsi

15:35 Global Overview of Universal Salt Iodization Programs  
* Dr. Michael Zimmermann

15:45 Program Elements in Successful Universal Salt Iodization Efforts  
* Dr. Robin Houston

16:00 TU4 Iodine Fortification in a Country with Mild to Moderate Iodine Deficiency – Good or Bad? Experiences from a Monitoring Program  
* Dr. Lone Banke Rasmussen

16:10 TU5 High Urinary Iodine Excretion Level Among Ugandan Children Calls for a Regional Solution  
* Dr. Elizabeth Madraa

* Readers can use the codes next to the presentation titles to locate abstracts of the presentations in the “ABSTRACTS” section of this book.
16:20  TU6  Sustainable Salt Iodization Using Cost Recovery Scheme for Small Scale Salt Producers in Senegal
       Mr. Banda Ndiaye

16:30  Questions and Answers
       Mr. Venkatesh Mannar

16:45  Summary and Conclusions
       Mr. Venkatesh Mannar

16:50  End of Tuesday’s Formal Sessions

19:00  Reception (off-site) hosted by the Local Organizing Committee led by the Chinese Center for Disease Control and Prevention

WEDNESDAY, 13 MAY 2009

Developmental Origins of Health and Disease: Early Micronutrient Exposure
Moderator: Prof. Chen Junshi
Co-moderator: Dr. Lindsay Allen

8:30  Developmental Origins of Health and Disease: Overview
       Prof. Peter Gluckman

8:55  Introduction to Nepal Cohorts Follow-up Study
       Dr. Parul Christian

9:00  W1  Effects of Antenatal Multiple Micronutrient Supplementation on Children's Weight and Size at 2 Years of Age in Nepal
       Dr. Anjana Vaidya

9:10  W2  Antenatal Iron Supplementation Reduces Childhood Mortality in Rural Nepal
       Dr. Parul Christian

9:20  W3  Effects of Antenatal Micronutrient Supplementation on Growth, Body Composition and Early Markers of Cardiovascular Risk Among 7 Year-old Children in Rural Nepal
       Dr. Christine Stewart

9:30  W4  Maternal Vitamin A Supplementation During Pregnancy Improves Lung Function in a Cohort of Preadolescent Children in Rural Nepal
       Dr. William Checkley
9:40  W5  The Extended Impact of Preschool Vitamin A Supplementation on Young Adult Hearing Loss in Southern Nepal
   Ms. Jane Schmitz

9:50  Questions and Answers
   Prof. Chen Junshi

10:05  Summary and Conclusions
   Dr. Lindsay Allen

10:10  Break, Posters, and Exhibit Viewing

Maternal Iron-Folic Acid Supplementation: Great Policy, Failed or Forgotten Implementation?
   Moderator: Dr. Lisa Rogers
   Co-moderator: Prof. Zhang Ting

11:10  Maternal Iron-Folic Acid Supplementation Programs: Evidence of Implementation and Impact
   Dr. Tina Sanghvi

11:25  W6  Nepal Drastically Reduces the Prevalence of Anaemia in Pregnant Women in the Past Five Years-From 75% To 42%
   Mr. Naveen Paudyal

11:35  W7  Factors Associated with Neonatal Mortality in Indonesia: The Role of Iron/Folic Acid Supplements
   Dr. Christiana Titaley

11:45  W8  Large Scale Multi-state Anemia Control Program for Adolescent Girls in India
   Dr. Mohamed Ag Ayoya

11:55  Iron and Folic Acid Supplementation in Pregnancy; Is It Necessary, Does it Work and How Should We Assess its Effectiveness?
   Dr. Sean Lynch

12:15  Questions and Answers
   Dr. Lisa Rogers

12:25  Summary and Conclusions
   Dr. Tina Sanghvi
### SIGHT AND LIFE Young Investigators Award

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<tr>
<td>12:40</td>
<td>Introduction and Presentation of Finalists</td>
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<td>Dr. Klaus Kramer</td>
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<tr>
<td>12:50</td>
<td>Presentation of Winning Abstract</td>
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<td>Winner of the SIGHT AND LIFE Young Investigators Award</td>
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<tr>
<td>13:00</td>
<td>Questions and Answers</td>
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#### Food Fortification Programs: Evidence of Implementation and Impact

- **Moderator:** Dr. Barbara Macdonald  
  **Co-moderator:** Prof. Huo Jungsheng

<table>
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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>15:00</td>
<td>Basic Principles and State of the Art on Mass Food Fortification</td>
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<td>Dr. Rafael-Flores Ayala</td>
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</tbody>
</table>
| 15:15 | W9 Reflections on Lessons Learned Since 2004 from the South African Flour Fortification Programme  
       | Ms. Maude de Hoop                                                    |
| 15:25 | W10 Consumption of NaFeEDTA Fortified Wheat Flour Improves Body Iron Stores in Urban Indian School Children  
       | Dr. Sumithra Muthayya                                                |
| 15:35 | W11 Dual Fortification of Salt with Iodine and Iron: A Randomized, Double-blind, Controlled Trial in Southern India of Micronized Ferric Pyrophosphate and Encapsulated Ferrous Fumarate  
       | Ms. Maria Andersson                                                  |
| 15:45 | W12 The Food Control System of Fortified Foods of Uganda Shows that Programs of Salt and Oil Fortification are Occurring According to Specifications  
       | Dr. Elizabeth Madraa                                                 |
| 15:55 | Questions and Answers                                               |
|       | Dr. Barbara Macdonald                                                |
| 16:05 | Summary and Conclusions                                              |
|       | Dr. Omar Dary                                                        |
| 16:15 | End of Wednesday’s Formal Sessions                                  |
THURSDAY, MAY 14, 2009

Scaling-up New Technologies, Evidence of Implementation and Impact: Micronutrient Powders and Spreads

Moderator: Dr. Arnold Timmer
Co-moderator: Prof. Li Duo

8:30 Renewed Interest in the Role of Food/Food Products in the Fight Against Malnutrition; a Revolution or Just Common Sense?
Dr. Martin Bloem

8:45 TH1 Research to Practice: A Multisectoral Approach to Product Development, Research and Global Distribution to Prevent Micronutrient Deficiencies
Dr. David Yeung

8:55 TH2 Distribution of Multi-micronutrient Sprinkles™ Through the Community-based Lady Health Workers Effective in Reducing Anemia in 6-23 Months Children in Rural Pakistan
Dr. Noor Ahmad Khan

Mr. Laird Ruth

9:15 TH4 Weight Gain and Retention in Women Supplemented with One of Three Supplements with Identical Micronutrient Content in Mexico
Dr. Lynnette Neufeld

9:25 Questions and Answers
Dr. Arnold Timmer

9:35 Summary and Conclusions
Dr. Martin Bloem

9:45 Break, Posters and Exhibits Viewing

Zinc Treatment for Diarrhea Management and Control

Moderator: Dr. Kenneth Brown
Co-moderator: Prof. Yin Shi’an

10:35 Unexpected Realities of Introducing a New Intervention—The Zinc and Diarrhea Story from Policy to Present
Dr. Christa Fischer-Walker
10:50  TH5  Scaling Up Zinc as Treatment of Childhood Diarrhea in Bangladesh  
Dr. Tahmeed Ahmed

11:00  TH6  Introducing Pediatric Zinc Through the Private Sector in Nepal  
Mrs. Vicky MacDonald

11:10  TH7  Tanzania Public-Private Partnership to Promote Rational Diarrhea Management  
Mr. Christian Winger

11:20  TH8  Effectiveness of Zinc Supplementation Plus Oral Rehydration Salts Compared with Oral Rehydration Salts Alone as a Treatment for Acute Diarrhea in a Primary Care Setting: A Cluster Randomized Trial  
Dr. Nita Bhandari

11:30  Questions and Answers  
Dr. Kenneth Brown

11:40  Summary and Conclusions  
Ms. Emily Wainwright

11:45  Break

Agricultural-based Programs: Biofortification

Moderator: Dr. Erick Boy  
Co-moderator: Prof. Luo Yunbo

12:05  Introduction to Biofortification Concepts and Overview  
Dr. Christine Hotz

12:20  TH9  Vitamin A Equivalence Of Beta-Carotene-Biofortified Maize In Women  
Dr. Wendy White

12:30  TH10  Golden Rice as a Food Source of Vitamin A  
Dr. Guangwen Tang

12:40  Questions and Answers  
Dr. Erick Boy
PANEL: Private Sector Strategies for Reducing Micronutrient Malnutrition: Opportunities and Challenges in Reaching the Bottom of the Pyramid

Moderator: Mrs. Jane Badham

12:50 Opening Remarks
Dr. Alfred Sommer

Introduction: Results from a Survey among Private Sector Companies
Mr. Venkatesh Mannar

Panel Participants
Mr. Stephan Tanda, Member of the Managing Board, DSM, Netherlands
Mr. Hans Arnold, Technical Executive, Tiger Brands, South Africa
Mr. Greg Harvey, CEO, Interflour Group, Singapore
Dr. Mehmood Khan, Chief Scientific Officer, Pepsico, USA,
Dr. Saskia Osendarp, Lead Scientist Child Nutrition, Unilever, Netherlands
Mr. Sun Loke, Director of Manufacturing, Amway, China

13:50 End of Thursday’s Formal Sessions

FRIDAY, 15 MAY 2009
Micronutrients and Maternal, Newborn and Child Health: New Research Findings

Moderator: Dr. Frances Davidson
Co-moderator: Prof. Su Yixiang

8:30 F1 Neonatal Vitamin A Supplementation for the Prevention of Mortality and Morbidity in Infancy: Systematic Review of Randomized Controlled Trials
Dr. Siddhartha Gogia

8:40 An Alternative Interpretation of the Systematic Review of Neonatal Vitamin A Supplementation
Dr. James Tielsch

Dr. Juan Pablo Peña-Rosas

9:00 Open Discussion
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<td>9:15</td>
<td>F2</td>
<td>The ObaaPaVitA Trial: Impact of Weekly Vitamin A Supplementation (VAS) on Pregnancy-Related Mortality in Ghana</td>
<td>Dr. Betty Kirkwood</td>
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<td>9:35</td>
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<td>Questions and Answers</td>
<td>Dr. Frances Davidson</td>
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<td>F3</td>
<td>What is the Effect of Starting Micronutrient Supplements Early in Pregnancy on Birthweight, Duration of Gestation and Perinatal Mortality? A Double-blind Cluster Randomized Controlled Trial in Rural Western China</td>
<td>Dr. Michael Dibley</td>
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<td>Break, Exhibit and Poster Viewing</td>
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<td>Moving Beyond Coverage: Achieving Sustainability</td>
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<td>Moderator: Dr. Ellen Piwoz</td>
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<td>Co-moderator: Prof. Ma Guansheng</td>
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<td>Aspects of Sustainable Programs</td>
<td>Dr. Michael Zeilinger</td>
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<td>F4</td>
<td>Shifting Financial Support for the Vitamin A Supplementation (VAS) Program from External Donors to National Sources did not Reduce Coverage in Senegal</td>
<td>Dr. Djibril Cisse</td>
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<td>11:55</td>
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<td>Enhancing Realistic Planning and Budgeting for Twice-Yearly Vitamin A Supplementation in the Context of a Health SWAp and Decentralized Health System – Experiences from Tanzania</td>
<td>Mr. Joseph Mugyabuso</td>
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<td>F6</td>
<td>Review of Supply versus Utilization: Supply Chain Improvements for Vitamin A Capsules in DRC, Indonesia, Kenya, Nigeria, Pakistan and the Philippines</td>
<td>Ms. Alison Grieg</td>
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<td>Addressing Pharmaceutical Management to Reduce Micronutrient Deficiencies</td>
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12:25  Questions and Answers  
*Dr. Ellen Piwoz*

12:35  Lunch and Poster Viewing

### Micronutrient Metabolism

**Moderator:** Dr Lindsay Allen  
**Co-moderator:** Prof. Yang Xiaoguang

13:45  Introduction to Genomics and Proteomics  
*Prof. Bo Lönnerdal*

14:00  **F8** Two Common Single Nucleotide Polymorphisms in the Gene Encoding Beta-carotene 15,15'-monooxygenase Alter Beta-carotene Metabolism in Female Volunteers  
*Dr. Georg Lietz*

14:10  **F9** Serum Retinol to Retinol-Binding Protein (RBP) is Low in Obese Adults due to Elevated apo-RBP  
*Prof. Sherry Tanumihardjo*

14:20  **F10** Serum Proteome Reflects Maternal Micronutrient Status in Nepal: A Study of the Nutriproteome to Discover Micronutrient Biomarkers  
*Dr. Keith P. West Jr.*

14:30  Questions and Answers  
*Dr. Lindsay Allen*

14:45  Break

### Evidence-based Impact of Poverty Alleviation Programs: Maximizing Nutritional Benefits

**Moderators:** Dr. Victoria Quinn  
**Co-moderator:** Prof. Zhu Ling

15:15  Overview of Poverty Alleviation Programs-Evidence of Nutritional Impact and Ways to Strengthen Nutritional Component of Poverty Alleviation Programs  
*Dr. Marie Ruel*
15:30  F11  Homestead Food Production Contributes to Household Food and Nutrition Security and Decreased Anemia Among Young Children - Lessons Learned from Scaling-up Programs in Asia (Bangladesh, Cambodia, Nepal and Philippines)
Mr. Aminuzzaman Talukder

15:40  F12  Breakthrough Technologies and Approaches to Ensure All-year-round Adequate Supply of Micronutrients through Vegetable Gardening
Ms. Juliet Aphane

15:50  F13  Conditional Cash Transfer Programs and Micronutrient Deficiencies: Are We Missing an Opportunity?
Dr. Marie Ruel

16:00  Questions and Answers
Dr. Victoria Quinn

16:10  Concluding Remarks and Closing Ceremony of the Beijing Micronutrient Forum
Dr. Alfred Sommer

16:40  End of Formal Sessions of the Micronutrient Forum
# Poster Schedule at a Glance

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<td>Iodine and Universal Salt Iodization</td>
<td>12:30 to 13:30</td>
<td>TU7-TU24</td>
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<tr>
<td>Vitamin A Deficiency and Vitamin A Supplementation Interventions</td>
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<td>Micronutrient Status Methodologies</td>
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<td>Micronutrient Surveys</td>
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<td>12:30 to 13:30</td>
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<td><strong>Wednesday, 13 May 2009</strong></td>
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<td>Developmental Origins of Health and Disease: Early Micronutrient Exposure</td>
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<td>Food Fortification</td>
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<td>Anemia, Iron Deficiency and Iron Supplementation Interventions - Infants</td>
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<tr>
<td>Anemia, Iron Deficiency and Iron Supplementation Interventions - Adolescents</td>
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<td><strong>Thursday, 14 May 2009</strong></td>
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<td>9:30 to 10:30</td>
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<td>Scaling-up New Technologies: Micronutrient Powders, Spreads, Home-based Fortification</td>
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<td>Zinc Deficiency, Zinc Supplementation, and Zinc Treatment of Diarrhea</td>
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<td>Vitamin D, K, and B12 Deficiencies</td>
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<td>Micronutrient Metabolism</td>
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<td>Micronutrients and Infectious Disease (HIV, TB and Malaria)</td>
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<td>Poverty Alleviation and Food Production Programs</td>
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1. Presenters will be by their posters at these times.
2. Posters will be identified in the “ABSTRACTS” section of this book according to these codes.
# Poster Presentations

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<td>Prof. Amal A M Saeed</td>
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<td>TU8</td>
<td>Assessment of Use of Iodized Salt at Household Level and Iodine Deficiency Status among Children Under Five Years and Women of Reproductive Age Group, Residing in the Province of Sindh, Pakistan</td>
<td>Prof. Imtiaz Hussain</td>
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<td>TU9</td>
<td>Results of the National Survey on Iodine Supply IDD Prevalence among Children in Kyrgyz Republic in 2007.</td>
<td>Dr. Aigul Musambetova</td>
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<td>TU10</td>
<td>Use of Iodized Salt in Processed Foods: Implications on USI Strategies</td>
<td>Ms. Lucie Bohac</td>
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<td>TU11</td>
<td>Some Critical Success Factors in Achieving Sustained Elimination of Iodine Deficiency in Kazakhstan</td>
<td>Prof. Shamil Tazhibayev</td>
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<td>Challenges to Elimination of Iodine Deficiency Disorders in the Russian Federation</td>
<td>Prof. Ekaterina Troshina</td>
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<td>TU14</td>
<td>Iodised Oil Supplementation is a Practical Alternative to Iodised Salt in Protecting the Developing Brain from IDD – Experience from Tibet</td>
<td>Dr. Mu Li</td>
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<td>TU15</td>
<td>Urinary Iodine Concentration in Matched Pairs of Thai Pregnant Women and Their School-aged Children</td>
<td>Mr. Sueppong Gowachirapant</td>
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<td>TU16</td>
<td>Power From Below – Test Kits in the Hands of Retailers Force Producers to Iodize Salt</td>
<td>Dr. Tobias Schueth</td>
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<td>TU17</td>
<td>Promotion of Iodised Salt by Community Based Organisations and Community Retailing Drastically Increases the Use of Iodised Salt in Southern Nepal</td>
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<td>Achievement of Universal Salt Iodisation Ensures Optimum Iodine Nutrition of School-age Children but Not Pregnant Women in Serbia</td>
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<td>Dr. Juliawati Untoro</td>
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<td>Prof. Abu Ahmed Shamim</td>
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<td>TU21</td>
<td>Successful Elimination of Iodine Deficiency Disorders (IDD) in Azerbaijan is Challenged by Low Quality of Locally Produced Iodized Salt</td>
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<td>On the Performance of Rapid Salt Iodine Tests to Assess the Coverage of Iodized Salt in Large-Scale Surveys</td>
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<td>Gestational Iodine Deficiency (ID) and Neuropsychological Development of Children at Five Years of Age in Rural Bangladesh: Categorization of Gestational Iodine Status by Multiple Indicators</td>
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<td>Successful Implementation of the National Vitamin A Supplementation Program Contributed to Improved Child Survival in Niger from 2000 to 2006</td>
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<td>Effective Approaches to Vitamin A Supplementation in Orissa, India: Reflections from a Decade of Policy Enforcement and Program Implementation</td>
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<td>Do Elevated Levels of Alpha-1 Acid Glycoprotein (AGP) Affect the Prevalence of Anemia in Preschool Children?</td>
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<td>Systematic Review and Evaluation on Chinese Dietary Vitamin Intake and Deficiency in Recent Eight Years</td>
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<td>Assessment of Vitamin A Deficiency in Women and Children from Papua New Guinea using Dried Blood Spot Retinol-Binding Protein</td>
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TU70  Barriers to the Development of a Field Tool to Determine Anemia, Iron Deficiency, Inflammation, and Malaria  
Mr. Christopher Crudder

TU71  The Importance of Correcting for Inflammation for the Assessment of VAD  
Ms. Rhona Baingana

TU72  Identifying Iron Deficiency Anemia in Developing Country Community Settings: RDW with Hemoglobin as an Investigative Tool in Public Health  
Ms. Usha Dhingra

TU73  Assessment of Retinol-binding Protein as a Substitute for Serum Retinol in the Relative-dose-response Test for Determining Hepatic Vitamin A Stores  
Prof. Masako Fujita

TU74  Influence of Inflammation on Serum Ferritin and Transferrin Receptor Concentrations and sTfR: FER Ratios in a Nationally Representative Sample of Lao Women and Children  
Dr. Jacqueline Knowles

TU75  Evaluation of WHO Hemoglobin Color Scale and Palmar Pallor for Screening of Anemia among Children (6-35 Months) in Rural Wardha, Central India  
Prof. Pradeep Deshmukh

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**Posters on Micronutrient Surveys**

TU76  Anemia in Latin America and the Caribbean, a Significant Public Health Challenge  
Dr. Jose O Mora

TU77  The National Survey of Anemia and Iron Deficiency in Georgia  
Dr. Maka Danelia

TU78  The Survey of Synthesis Nutritional Supplement on 3-6 Years Old Children of Zinc, VA, VB2, VC Deficiency in Yugu, Dongxiang, Baoan Nationalities  
Prof. Wangyu Wangyu

TU79  Magnitude and Causes of Multiple Micronutrient Deficiencies among Filipino Pregnant Women  
Prof. Leah A. Perlas

TU80  Anemia - An Epidemic in India  
Prof. Sangeeta Saxena

TU81  Hypomagnesemia: Prevalence and its Associations with Hypocalcemia, Zinc Deficiency and Giardia Intestinalis in Rural Tanzanian Children  
Dr. Jacobien Veenemans

TU82  Iron and Vitamin A Status in Papua New Guinea: Results of a 2005 National Survey  
Ms. Katherine Tripp

TU83  Anemia Situation in Two Philippine Provinces: Implications for the Development of an Integrated Anemia Prevention and Control Programme  
Ms. Angelina Felix
The applicants for the SIGHT AND LIFE Young Investigators Award are co-authors in a selection of abstracts accepted for oral or poster presentation at this meeting. The reference codes noted in the table below can be used to locate the abstracts on the “ABSTRACTS” section of this book.

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<td>Validation of Dietary Diversity Score as Indicator of Nutrient Adequacy</td>
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<td>Effect of Food Processing and Storage on the Stability of Lycopene and Beta-Carotene in Tomatoe Varieties in Morocco and Its Derived Products</td>
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**Posters on Zinc Deficiency, Zinc Supplementation, and Zinc Treatment of Diarrhea**

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**Posters on Micronutrient Program Management, Monitoring and Sustainability**

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F18 Assessing the Sustainability of Anaemia Control Programs in Ghana and Malawi  Dr. Carolyn MacDonald

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Prof. Ngozi Nnam

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Dr. Agnes Guyon
Organizers

The Micronutrient Forum Program Committee and Secretariat planned and organized the Beijing Meeting of the Micronutrient Forum through A2Z, the USAID Micronutrient and Child Blindness Project at the Academy for Educational Development (AED). The Local Organizing Committee led by the Chinese CDC is the key advisory body to the Micronutrient Forum Secretariat, providing operational and financial assistance in the preparation and execution of the meeting. The organizers include representatives of United Nations technical agencies, bilateral agencies, foundations, universities, the private sector, and non-governmental organizations. The Office of Health, Infectious Disease and Nutrition, at USAID and the Chinese Center for Disease Control and Prevention, assumed major responsibility for organizing the meeting. In addition to financial support, the Bill & Melinda Gates Foundation and SIGHT AND LIFE contributed to the planning and development of the meeting content.

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A2Z, the USAID Micronutrient and Child Blindness Project, which is managed by the Academy for Educational Development (AED), serves as the Secretariat for the Micronutrient Forum, with funding from the United States Agency for International Development (USAID).

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Exhibits

Exhibits are located on the 2nd Floor Exhibition Area of the Beijing International Convention Center (BICC), and will be on display from Tuesday, 12 May 2009 to Friday, 15 May 2009.

Amway China Limited

A2Z, the USAID Micronutrient & Child Blindness Project

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Child Health Nutrition Research Initiative (CHNRI)

Chinese Center for Disease Control and Prevention and International Life Sciences Institute Focal Point in China

Coca-Cola Company

Flour Fortification Initiative

Global Alliance for Improved Nutrition (GAIN)

Harvest Plus

International Zinc Nutrition Consultative Group (IZINCG)

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Micronutrient Forum

PATH Ultra Rice Project

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U.S. Agency for International Development (USAID)

U.S. Centers for Disease Control and Prevention (CDC), International Micronutrient Malnutrition Prevention and Control (IMMPaCt) Program

World Initiative for Nutrition (WIN), a business unit of Fortitech
Abstracts

Abstracts that appear in this booklet were selected for presentation at the Micronutrient Forum.
GLOBAL PREVALENCE OF VITAMIN A DEFICIENCY IN POPULATIONS AT RISK

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Conclusions: Impacts on child mortality are estimated to be large and a small improvement in vitamin A status among children could result in significant reductions in child mortality. We conclude that vitamin A supplementation programs continue to be an important public health intervention to reduce child mortality. Further, we demonstrate how the SROL approach can be used to monitor the effectiveness of vitamin A supplementation programs. The SROL value is a direct measure of the vitamin A status in a population, which in turn is strongly associated with child mortality. We provide guidance for interpreting the SROL value in practice, and describe how this approach can be used to evaluate both large-scale vitamin A supplementation programs and small-scale vitamin A interventions. We also provide a framework for understanding the role of vitamin A in child mortality.”

MEASURING THE ASSOCIATION BETWEEN HIGH-COVERAGE VITAMIN A PROGRAMS AND REDUCTIONS IN UNDER-FIVE MORTALITY: EVIDENCE FROM NATIONAL SURVEYS

A. Pluquen

Background: In the last two decades, under-five mortality has decreased globally, with many countries making significant progress. A number of studies have attempted to attribute reductions in under-five mortality to vitamin A supplementation programs implemented in the 1980s and 1990s. These studies have focused on the association between vitamin A supplementation programs and reductions in under-five mortality. However, these studies have not taken into account the potential impact of other interventions that may have also contributed to the reductions in under-five mortality. The aim of this study is to estimate the association between high-coverage vitamin A supplementation programs and reductions in under-five mortality, while controlling for other interventions that may have also contributed to the reductions in under-five mortality.

Methods: We used a cross-country analysis to estimate the association between high-coverage vitamin A supplementation programs and reductions in under-five mortality. We used data from the WHO Child Health and Nutrition Surveys, the WHO Global Database on Large-Scale Nutrition Interventions, and the WHO Global Database on Child Health and Nutrition. We used a fixed-effects model to estimate the association between high-coverage vitamin A supplementation programs and reductions in under-five mortality, while controlling for other interventions that may have also contributed to the reductions in under-five mortality.

Results: The results of the cross-country analysis showed that high-coverage vitamin A supplementation programs were associated with reductions in under-five mortality. The results also showed that other interventions, such as breastfeeding, immunization, and improved sanitation, also contributed to the reductions in under-five mortality. The results also showed that the association between high-coverage vitamin A supplementation programs and reductions in under-five mortality was stronger in countries with better overall health systems.

Conclusions: The results of this study suggest that high-coverage vitamin A supplementation programs are associated with reductions in under-five mortality. However, the results also suggest that other interventions, such as breastfeeding, immunization, and improved sanitation, also contributed to the reductions in under-five mortality. The results also suggest that the association between high-coverage vitamin A supplementation programs and reductions in under-five mortality is stronger in countries with better overall health systems. Therefore, future studies should focus on understanding the role of other interventions in the reductions in under-five mortality, as well as how to improve the effectiveness of vitamin A supplementation programs in countries with weaker health systems.”

IODINE FORTIFICATION IN A COUNTRY WITH MODERATE IODINE DEFICIENCY – GOOD OR BAD? EXPERIENCES FROM A MONITORING PROGRAM

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Introduction: Iodine deficiency is one of the most widespread nutritional deficiencies in the world, affecting more than 2 billion people. Iodine deficiency results in a range of health problems, including iodine deficiency disorders (IDD). IDD includes hypothyroidism in adults and children, goitre in adults, and cretinism in children. Iodine deficiency is preventable through iodine supplementation programs. However, the implementation of these programs has been inconsistent, and the impact of iodine supplementation on health outcomes has been variable. This study aimed to assess the impact of iodine supplementation programs in a country with moderate iodine deficiency.

Methods: This study used a cross-sectional design to assess the impact of iodine supplementation programs in a country with moderate iodine deficiency. The study used data from the national household surveys conducted in the country before and after the introduction of iodine supplementation programs. The data were analyzed using descriptive and inferential statistical methods. The study also used the World Health Organization’s (WHO) recommendations for monitoring iodine supplementation programs to assess the impact of the programs.

Results: The results of the study showed that the introduction of iodine supplementation programs in the country was associated with an increase in iodine intake. The results also showed that the increase in iodine intake was accompanied by a reduction in the prevalence of iodine deficiency. However, the results also showed that the increase in iodine intake was not accompanied by a reduction in the prevalence of hypothyroidism. The results also showed that the increase in iodine intake was not accompanied by a reduction in the prevalence of goitre. The results also showed that the increase in iodine intake was not accompanied by a reduction in the prevalence of cretinism.

Conclusions: The results of this study suggest that iodine supplementation programs are effective in increasing iodine intake in a country with moderate iodine deficiency. However, the results also suggest that iodine supplementation programs are not effective in reducing the prevalence of iodine deficiency, hypothyroidism, goitre, or cretinism. Therefore, the results of this study suggest that iodine supplementation programs should be complemented by other interventions, such as dietary diversification and education, to improve the impact of iodine supplementation programs on the prevalence of IDD.”
**TU05**

**HIGH URINARY IODINE EXCRETION LEVEL AMONG UGANDAN CHILDREN CALLS FOR A REGIONAL SOLUTION**

J Sabiiti1, E Ategbo2, B Kaijuka2, J Twatwa1

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**Background:** Iodine Deficiency Disorders (IDD) were recognized as a public health problem in Uganda since 1965. However, it was not until 1994 that large scale interventions to eliminate IDD through Universal Salt Iodization started. Since 1994, vigilance at the border entry points has been high. A national survey was carried out in 2005, to assess the progress made.

**Objectives:** The survey had two i) to estimate the level of urinary iodine excretion (UIE) in the population; and ii) to assess the proportion of households consuming iodized salt at the national requirement level of 15 ppm.

**Methods:** A cross-sectional study was applied by stratifying the country into 4 geographic regions. In each region, 30 clusters were selected proportionate-to-population-size and 10 school children were enrolled per cluster using a two-stage systematic random sampling approach. Presence of iodine in salt was estimated using salt testing kit and UIE level by a quality-assured colorimetric method.

**Results:** Proportion of households consuming adequately iodized salt was found to be high in all regions reaching 99.3% in the central region. National average stands at 87.6%. Median UIE, ranged from 188 mcg/l in the West to 564.2 mcg/l in the North. National median level is 463.2 mcg/l. Proportion of children with UIE < 100 mcg/l ranged from 62.4% in the West to 84.2% in the North. Every other child has UIE > 500 mcg/l. Since this study carried out in 2005, more progress has been made as revealed by the Uganda Health and Demography Survey (UDHS) of 2006 in which 96% of households were found to be consuming adequately iodized salt. Although the UDHS did not include UIE study it is likely that the high UIE level still persists.

**Discussion:** Uganda Legislation on indication of edible salt stipulates levels of 100 ppm at production, wholesale 6.0 ppm at retail, which are higher than the WHO/IHCC/UNICEF recommendation. In addition, quality assurance skewed toward the lower end, may also explain high level of iodine in salt. Similar situation is observed in Kenya which is the main supplier of salt to Uganda. Other countries in the region face similar problems.

**Conclusion:** Long term effect of exposure to high level of iodine is still unclear. However, there is an urgent need to bring legislation in line with global recommendations and improve quality assurance of iodized salt. Considering that salt consumed in Uganda is supplied by Kenya where level of iodization in Kenya is fixed at 100 ppm and recognizing that Uganda market is not big enough to influence salt production pattern in Kenya, a regional approach is required.

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**TU06**

**SUSTAINABLE SALT IODIZATION USING COST RECOVERY SCHEME FOR SMALL SCALE SALT PRODUCERS IN SENEGAL**

B Ndiaye1, I Ndao1, A Miloff4, I Dia2, N Toure3, K Dieng3

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**Background:** Senegal is the largest producer and trader of salt in West Africa. An estimated 150,000 MT of its 450,000 MT annual yield is produced by small-scale salt producers who supply both local market and neighbouring country needs. According to a 2006 baseline survey, potassium iodate (KIO3) was not available at 63% of the salt production sites and 71% of salt iodization machines previously provided were out of service.

**Aims:** To improve adequately iodized salt production by small salt producers using a revolving fund model to ensure the sustainable availability of potassium iodate and functioning salt iodization machines.

**Methods:** A cost recovery scheme was designed and developed from participative stakeholder consultations with small-scale producers that focused on how USI bottlenecks could be resolved at local level. Free of charge salt iodization machines and initial KIO3 stock were provided to producer associations, called GIEs (Groupement d’Intérêt Économique), organized to provide salt iodization processing services on a full cost recovery basis. (Groupings of producers were based on socio-cultural affinity and geographic proximity). Regional groupings of GIEs, called federations, received initial KIO3 donations along with spare machine parts and were mandated to use their stocks to set up local central purchasing units. According to the cost recovery scheme, GIEs are required to save their income in local banks to be spent on services such as repairing machines, replenishing fuel, making labour payments and especially restocking KIO3 from their local Federation.

**Results:** An additional 89,772 metric tons of iodized salt were produced (more than 60% of Senegal’s estimated annual small producer capacity) in a year. Production trends and informal discussions with producers indicated increased commitment and compliance of producers and distributors with salt iodization. GIEs were able to pay for regular repairs by local mechanics on request, ensuring the continued functioning of the iodization units, and to make purchases of iodate adequate to replace the amounts consumed (1.53 MT of iodate purchased using US$54,000 of income recovered in 8 months).

**Conclusions:** In addition to initial equipment and inputs support, a cost recovery scheme developed by and in close consultation with producers proved to be a suitable way of engaging small-scale salt producers in salt iodization. Further work will be needed over time to identify other factors that may be critical for securing their sustained long term engagement in salt iodization.
SELECTED POSTER PRESENTATIONS

TU07  SIMPLE GOITRE EPIDEMIOLOGY AND AETIOLOGY IN THE SUDAN

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Introduction: Iodine deficiency is the world’s most common endemic disease. It is a cause of endemic goiter and serious pathological consequences. These include mental defects, deaf mutism, stillbirth and miscarriages, weakness and paralysis of muscles as well as lower degree of physical and mental functions. Sudan was reported repeatedly as iodine endemic area. The endemicity of iodine deficiency in the Sudan was due to the high endemicity of water iodine deficiency. The second major factor was thiocyanate originating from the increased consumption of meat in some populations. The previous iodine studies were conducted in the Darfur region in the Western Sudan, which is remote from the seaside. There was a national survey for assessment of iodine deficiency in the Sudan in 1997. The general objective of this study was to map the prevalence of goiter in the Sudan and to study the ecological factors involved. A further objective was to estimate the use of serum thyroglobulin (Tg) level in the assessment of iodine status. The results of this study indicated that the overall total iodine status was 40.62%, the highest iodine value was found in Kosti town in the centre of the Sudan (77.6%) and the lowest in capital Khartoum (12.2%). The overall median urinary iodine concentration was 6.55 μg/dl. Iodine deficiency was detected in 78.28% of the children and there were great variations in the median UI from region to another started from 2.78 μg/dl in Kosti town to 46.40 μg/dl in Port Sudan city (at the coast of the Red Sea). The overall median concentration of thyroxine in the urine was 0.37 mg/dl. There were also variations in the median levels of urinary thyroxine from a region to another. The Mean + SD serum concentration of thyroid hormones T4, T3, TSH and Tg were 112.78±23.83 μmol/l, 1.90±0.40 μmol/l, 1.83±0.14 μl/l and 23.3±1.12 μg/ml respectively. They were all within the normal reference range. Water samples analysis indicated that, Calcium, Magnesium, total Hardness, Chloride and Fluoride ions were present in high concentrations that exceeded in some samples the maximum permissible concentrations.

Discussion: The results of this study indicated that high concentrations of water chemicals are strongly interfering with the iodine metabolism and consequent thyroid function and anatomy. There were no statistical correlations between iodine prevalence and urinary iodine or thyroxine excretions. The result of thyroid hormones indicated that serum T4, T3 and TSH were in the normal range in iodine deficient populations. Measurement of these hormones did not reflect the iodine status or iodine prevalence in the populations studied. Determination of these hormones was not the suitable indicator for iodine monitoring programs. Although there was no statistical correlation between serum thyroglobulin concentration and the prevalence of iodine, the result of this study showed that high serum thyroglobulin concentrations were found in Kosti where the iodine intake was minimum, and in Port Sudan where high concentrations of water chemical were antithyroid activity. The serum thyroglobulin level in this study as well as the urinary iodine concentration can be taken as a base line data for the iodine supplementation program.

TU08  ASSESSMENT OF USE OF IODIZED SALT AT HOUSEHOLD LEVEL AND IODINE DEFICIENCY STATUS AMONG CHILDREN UNDER FIVE YEARS AND WOMEN OF REPRODUCTIVE AGE GROUP, RESIDING IN THE PROVINCE OF SINDH, PAKISTAN

I Hussain, G Nawaz, S Soofi, A Karmani, A Rizvi, Z Bhutta

Aga Khan University, Karachi, Pakistan

Introduction: Iodine deficiency disorders are recognized as the most preventable cause of mental health disorders worldwide, including Pakistan where over 70% of the population is estimated to be at risk of iodine deficiency disorders. This reported level of iodine deficiency has tremendous developmental costs on the country. The problem of iodine deficiency persists even in presence of salt fortified with iodine.

Objectives: The objectives of this study were to determine the prevalence of iodine deficiency in children (0–5 years) and women of reproductive age, and to assess the use of iodized salt at household level.

Methods: A cross sectional survey was conducted in urban and rural settings of Sindh Province, Pakistan from January 2007 to March 2009. Knowledge, attitudes and practices survey was conducted and a salt sample was tested for iodine fortification. A Urinary iodine Excretion test was employed on the study population to estimate the prevalence of iodine deficiency in this survey using the criteria recommended by WHO/UNICEF/ICCIDD (2001)

Results: The results of the present study revealed that majority of the respondents reported to be familiar with term of iodine and iodized salt and the availability of salt in nearby market. Locations wise the orientation level about iodine differed from 24% to 72% rural to urban areas accordingly. Iodine test kits were used to check the iodine content of household salt, which shows that the coverage of iodized salt within both rural and urban sites, about 39% respondents were reported to be using of iodized salt at household level but iodized salt were seen (by labeling observation) at 21% households at the time of household visit for interviews. The results for both reported use and observed use were differed location wise from 57% to 19% and 30.2% to 11.2% respectively in urban and rural. Results of urinary iodine analysis shows that about 36% reproductive age women were found to be iodine deficient; 14.6% were mildly iodine deficient and 19.2% moderately deficient. Among children under 5 years of age the prevalence of iodine deficiency was 22%, 12.2% were severely and 9.7% moderately iodine deficient. This high prevalence (52%) of iodine deficiency among children belonging to rural areas while a high prevalence was observed among women of reproductive age in urban areas.

Conclusions: Iodine deficiency still persists among children under 5 years of age and women of the reproductive age. Strict measures should be employed to counteract this deficiency, ensure use of iodized fortified salt, and consequent prevention for mental health defects.

TU09  RESULTS OF THE NATIONAL SURVEY ON IODINE SUPPLY AND IDD PREVALENCE AMONG CHILDREN IN KYRGYZ REPUBLIC IN 2007

R Sultanalieva, A Musambetova, G Ryspekova, S Mamutova, K Ormokoeva

Kyrgyz-Russian Slavonic University, Bishkek, Chui, Kyrgyzstan

The purpose of given research: to identify effectiveness of prophylactic activities based on the study of iodine supply and IDD prevalence among children of Kyrgyzstan.

Methods: Iodine deficiency still persists among children under 5 years of age and women of the reproductive age. Strict measures should be employed to counteract this deficiency, ensure use of iodized fortified salt, and consequent prevention for mental health defects.

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EvidEncE-basEd Programs

Micronutrients, HealTh and development:

TUESDAY, 12 MAY, 2009 Iodine and Universal Salt Iodization

ABSTRACTS

TU10 USE OF IODIZED SALT IN PROCESSED FOODS: IMPLICATIONS ON USI STRATEGIES

L. Borather1, J. de Jong3, A. Trevena1, K. Sullivan1

1Network for Sustained Elimination of Iodine Deficiency, Ottawa, ON, Canada; 2U.S. Salt, Brussels, Belgium; 3UNGCF, New York, United States

Background: The global strategy for the elimination of iodine deficiency is universal salt iodization (USI). In countries where the consumption of salt through processed foods rather than table salt is significant, and impetus for salt reduction has ended discretionary salt use, even with legislated iodation of table salt, iodation of table salt alone is unlikely to assure sufficient dietary iodine.

Aims: To understand the role of the use of iodized salt in the processed foods within the context of the global USI strategy and provide guidance on salt iodization policy and program management.

Methods: A survey for existence of laws regarding salt iodization, bibliographic search of technical reports on the current use of iodized salt in processed foods in a number of countries; literature review of the effects of iodized salt on food; interviews with representatives of the salt and processed foods industries.

Principle Findings: In principle USI was intended to include salt used in processed foods; this has not always been practiced and is further hampered by other factors. There is no consistency as to the legislated use of iodized salt in processed foods, in some countries it is mandatory and in others it is voluntary. Food processors are reluctant to use iodized salt stating concerns about its impact upon organoleptic properties of their food products as well as trade barriers created by differences in legislations between countries. USI program guidelines often do not specify measures, such as a baseline, minimum, or maximum use of iodized salt in processed foods. The review shows that iodized salt does not affect the quality of commonly used food products. There are examples of successful national strategies using iodized salt in processed foods as a means to address IDD.

Conclusions: As processed foods become diet staples, national iodine programs that mandate only table salt be iodized should consider expanding the mandate to include salt used in processed foods. The use of iodized salt in processed foods and health concerns over salt intake can coexist. The programmatic approach to USI should incorporate iodized salt in processed foods within the programme tools and standards. Complex considerations when applying iodized salt to processed foods, make the engagement of the processed foods industry at a national level essential.

TU11 SOME CRITICAL SUCCESS FACTORS IN ACHIEVING SUSTAINED ELIMINATION OF IODINE DEFICIENCY IN KAZAKHSTAN

T. Borather1, T. Thavanea1, T. Thawake, T. Ghasemian1, L. Khatkhuvin4, K. Kongplaph, H. Madaefrawi1, R. Risina, A. knassaa1, A. Knapova1, A. Knapova1

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Background: The Soviet Union’s historical record offers ample evidence that iodine deficiency was serious and widespread in virtually its entire salt territory. The Republic of Kazakhstan emerged as sovereign nation in 1991 and needed building its own national development strategy. An initial decade of economic transition led to sharply reduced iodized salt (IS) access, however. In 1999, the Demographic Health Survey revealed that IS was present in 29% of households while the median UI level was 13.5 mcg/l. In 2005 thyroid diseases were registered in 643,934 children, in 95% of them the main cause for thyroid ailment was iodine deficiency.

Aims: To understand the role of the use of iodized salt in the processed foods within the context of the global USI strategy and provide guidance on salt iodization policy and program management.

Methods: Systematic planning started in 2000 and culminated in formal multi-sector commitments at the Almaty Forum of October 2001. A National Coalition was formed, chaired by the Chief Health Inspector, and with members from a broad range of public, private and civic organizations. The Kazakh Academy of Nutrition was stimulated to play lead roles in technical and political advocacy and in a national communications campaign to promote public acceptance of USI.

Results: A Law “On Prevention of Iodine Deficiency Disorders”, accepted in Parliament in November 2003, is banning the sale and trade of non-iodized salt and thereby makes iodization compulsory for all edible, food-grade and fodder salt. The law specifies the exclusive use of potassium iodate and 40:15 mg iodine per kg as the normative salt iodine content. Between 2001 and 2006, the domestic salt production companies raised their combined IS production from 35,000 to 67,000MT. The balance of the ± 100,000MT national human use requirement is made up of imports, mainly from Russia and Ukraine. In 2006, a population-representative national micronutrient survey revealed that the median household salt iodine was 25.6mg/kg and adequately IS (≥ 15mg/kg) was being used in 92 percent of the households. The increased supply and use of iodized salt was accompanied by a suppressed improvement of iodine status. Between 1999 and 2006 the median urinary iodine among reproductive-age women increased from 55 to 250µg/L and the proportion <50µg/L decreased from 24 to 5 percent.

Conclusions: Iodine deficiency has been eliminated in Kazakhstan by a joint multi-sector collaborative approach, with oversight by a high-level National Coalition composed of all stakeholder organizations. The leading coordination role and continued championship by the Kazakh Academy of Nutrition is widely acknowledged for securing high public acceptance of USI as “The nutritional solution required for overcoming a nutrition problem”.

TU12 CHALLENGES TO ELIMINATION OF IODINE DEFICIENCY DISORDERS IN THE RUSSIAN FEDERATION

T. Borather1, G. Gerasimov2, O. Dary3, A. Arbuzova1, O. Dary3, M. Arbuzova1

1Network for Sustained Elimination of Iodine Deficiency, Ottawa, ON, Canada; 2EU Salt, Brussels, Belgium; 3Global Public Nutrition Services, Ltd

Background: The former Soviet Union has long been recognized as a public health problem in Cambodia. Significant efforts were undertaken over the past few years to increase coverage with and improve quality of iodized salt that is produced mainly in 2 coastal provinces of Kampt and Rep.

Aims: National survey was conducted to assess coverage of households with iodized salt and status of iodine nutrition of population and to allow for comparison with previous surveys.

Methods: A representative nationwide school-based survey was performed in Cambodia in 2008. Totally, 2,329 school-children aged from 8 to 10 years were assessed. Three clusters (schools) were randomly selected in each of 23 provinces and Phnom Penh representing both urban and rural populations. Within each cluster, 30 specimens of salt were tested qualitatively for iodine with rapid test kit (RTK), every fourth sample was tested quantitatively for iodine, and 15 urine specimens were collected for urinary iodine (UI) measurement.

Results: 2008 survey suggest that performance of the salt iodization program in terms of iodized salt coverage has remained virtually unchanged in the last 2.5 years: 73.7% of households were using salt that was identified as iodized at the time of this survey: the same proportion as in 2005. Virtually the same provinces were identified as failing the presence of sufficient proportion of iodized salt on household level only. 7% of households in Kep province were using iodized salt (27.7% in 2005), and 27.8% in Kampt (19.3% in 2005). In provinces (out of 24) 90% or more households used iodized salt, and 13 province had iodized salt coverage between 70% and 90%. For the salt that was iodized, the median iodine content was 25 mg/kg for the coarse salt and 32 mg/kg for the “refined” salt. However, the IDD elimination program has had a better performance when judged by UI excretion: 95% of Cambodia population resides in provinces with median UI level above 100µg/L. Low median UI levels (below 100µg/L) in Kep and Kampt provinces were clearly associated to low penetration of quality iodized salt.

Conclusions: With the exception of the salt producing provinces, the salt iodization program of Cambodia is providing sufficient iodine to almost entire population. However, in order to cover the whole population, special education programs on benefits of iodized salt should be implemented in the salt producing provinces. Furthermore, attention to quality of salt production and iodization should be kept, and the monitoring system strengthened.

TU13 SUCCESS OF NATIONAL PROGRAM FOR ELIMINATION OF IODINE DEFICIENCY DISORDERS IN CAMBODIA

N. Borth1, C. Vathana1, T. Sakhan1, S. Un2, O. Dary3, G. Gerasimov2

1Network for Sustained Elimination of Iodine Deficiency, Ottawa, ON, Canada; 2UNGCF Office in Cambodia, Phnom Penh, Cambodia; 3Asian Development Bank, Astana, Kazakhstan; 4Global Public Nutrition Services, Ltd

Background: Iodine Deficiency Disorders (IDD) has long been recognized as a public health problem in Cambodia. Significant efforts were undertaken over the past few years to increase coverage with and improve quality of iodized salt that is produced mainly in 2 coastal provinces of Kampt and Rep.

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SUNDAY, 11 MAY, 2009

ICNCD 2009

MICRONUTRIENTS, HEALTH AND DEVELOPMENT: EVIDENCE-BASED PROGRAMS

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12-15 MAY 2009 ♦ BEIJING, CHINA
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**TU14**

IODISED OIL SUPPLEMENTATION IS A PRACTICAL ALTERNATIVE TO IODISED SALT IN PROTECTING THE DEVELOPING BRAIN FROM IDD – EXPERIENCE FROM TIBET

S Gowachirapant, P Winichagoon, J Baumgartner, B Tong, L Wyss, M Zimmermann

Aims: To provide sufficient iodine to the most vulnerable populations in the community.

Methods: A Tibet region-wide supplementation program was implemented once a year from 2000 onwards. A solution of USI (USI = US halide + Iodine) to the oil in the capsulised oil was used. The oil is distributed to villages in remote areas who can least afford to purchase salt. To address this problem we implemented an iodised oil capsule (IOC) distribution program to infants and women of childbearing age (WCBA) as an interim strategy while working to create supply and demand for iodised salt in the Tibet Autonomous Region.

**Results:** The IOC program reached more than 95% of the target population. Median urinary iodine excretion (UIC) in these women increased from 19 mg/l to 169 mg/l.

Conclusions: We estimate that 170,000 children born in Tibet between 2000 and 2004 were protected from brain damage by iodised supplementation. While USI is the preferred solution to fight iodine deficiency worldwide, and has been successful in China, a practical and sustainable USI solution is yet to be found in Tibet, despite efforts such as responsibility contracts with local governments, setting up iodized salt distribution networks, evolving funds and importing iodized salt from neighboring provinces. The iodized oil supplementation program was implemented initially as an interim strategy to support and complement USI. However, it has proved to be an effective measure to protect the most vulnerable populations in the community and should be continued indefinitely.

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**TU15**

URINARY IODINE CONCENTRATION IN MATCHED PAIRS OF THAI PREGNANT WOMEN AND THEIR SCHOOL-AGED CHILDREN

Sowaliraphan, P Witsanugul, K Rungcharoen, T Xiong, M Wimmermann

Aim: To provide sufficient iodine to the most vulnerable populations in the community.

Methods: Pregnant women who met all criteria were asked to collect the urine samples and their ongoing programmes. To increase the availability of the packed salt, apart from setting up new depots, community retailing (primarily through women credit and saving groups) was also initiated.

Results: Within two years of campaign, the sales of the packed salt of large scale dealers has increased from 15% to 62%. Around 210 community groups that around 90% of retailers in villages have test kits. The approach is cost effective. Monitoring “from below” very effectively creates the issues of weak governance, fraud and smuggling in products and quickly understand the language of losing money.

Conclusions: The main lesson learnt is that retailers equipped with test kits can be a very powerful ally in forcing products to iodized salt and that such an approach is relatively cost low. Such monitoring “from below” very effectively creates the issues of weak governance, fraud and smuggling in products and quickly understand the language of losing money.

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**TU16**

POWER FROM BELOW – TEST KITS IN THE HANDS OF RETAILERS FORCE PRODUCERS TO IODIZE SALT

T Yamazaki, A Miyazaki, A Tamazawa, T Tamagawa

Background: Enforcing regulations on Universal Salt Iodization is difficult in many countries due to weak governance, corruption, porous borders and fraud. An approach was developed that creates effective commercial pressure on salt producers to take non-iodized salt off the market. After proving its effectiveness in one region it is now being implemented in the whole country.

Aim: Creating commercial pressure on salt producers by providing salt retailers with test kits for iodized salt for use at whole sale markets.

Methods: Strictly test kits are being used for monitoring purposes and in some cases also for educational purposes. The approach in Kyrgyzstan goes beyond this. At its core is the distribution of test kits to as many retailers as possible that sell salt. Only test kits for potassium iodate are used. Retailers are asked to use them at the whole sale markets when they purchase their salt.

Results: Most retailers use the test kits gladly, happy to help their communities fight a disease. Data from Village Health Committees (VHCs) where an approach that around 90% of retailers in villages have test kits. The approach is cost low. Purchasing test kits for the whole country with a population of about 35 Million people costs around 10000 USD per year. Coverage with iodated salt in Kyrgyzstan has reached over 90%. The involvement of retailers with test kits very likely has contributed greatly to this, on the basis of the usual technical assistance for producers and legislation and public awareness measures. When measuring the effect in one region we could document an increase of coverage with iodated salt from 71% to 93% within 6 months after providing retailers with test kits. (Food Nutr Bull, 26/4, 366-75, 2005).

Conclusions: The main lesson learnt is that retailers equipped with test kits can be a very powerful ally in forcing producers to iodize salt and that such an approach is relatively cost low. Such monitoring “from below” very effectively creates the issues of weak governance, fraud and smuggling in products and quickly understand the language of losing money.

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**TU17**

PROMOTION OF IODISED SALT BY COMMUNITY BASED ORGANISATIONS AND COMMUNITY RETAILING DRastically INCREASES THE USE OF IODISED SALT IN SOUTHERN NEPAL

G Khaire, K Kulkarni, S Shrestha, P Mathema, P Pokharel

Aim: The government is promoting the consumption of iodised salt with a quality assurance “Two Child” logo.

Methods: The key approach of the campaign has been mobilisation of NGOs and community based organizations (IBOs) to carryout promotion and monitoring activities on a partnership basis in one third of Village Development Committees with lowest use of the packed salt. In each Village, a mobilisation group was formed, which on a voluntary basis, conducted various promotional activities, retail interactions and took actions to control sale of the illegal salt. Every quarter household census and retail auditing has been also conducted to track the progress. Furthermore, alliance building with different partners and stakeholders were conducted to intensify awareness creation through integration of iodised salt promotion into their ongoing programmes. To increase the availability of the packed salt, apart from setting up new depot, community retailing (primarily through women credit and saving groups) was also initiated.

Results: Within two years of campaign, the sales of the packed salt of large scale dealers has increased from 15% to 62%. Around 210 community groups that around 90% of retailers in villages have test kits. The approach is cost effective. Monitoring “from below” very effectively creates the issues of weak governance, fraud and smuggling in products and quickly understand the language of losing money.

Conclusions: The main lesson learnt is that retailers equipped with test kits can be a very powerful ally in forcing products to iodized salt and that such an approach is relatively cost low. Such monitoring “from below” very effectively creates the issues of weak governance, fraud and smuggling in products and quickly understand the language of losing money.
TU18  ACHIEVEMENT OF UNIVERSAL SALT IODIZATION ENSURES OPTIMUM IODINE NUTRITION OF SCHOOL-AGE CHILDREN BUT NOT PREGNANT WOMEN IN SERBIA

O. Karfi, D. Pirovac, O. Priscic, F. Vesku

Background: Historically, iodine and preterm were significant public nutrition problems in former Yugoslavia and salt iodization was introduced already in the early 1990s, initially at a low level of 10mg KIO3. Present legislation mandates that all salt for human consumption in Serbia should be iodized at 12-15 mg iodine per kg. At the end 1990s, studies by the Public Health Institute of Serbia showed median urinary iodine (UI) of 158µg/L among school-age children. At that time, 73% of the households used iodized salt (IS).

Aim: A national survey in 2007 aimed to: (a) re-confirm the adequacy of IS use in the population, and (b) explore the iodine status among school-age children and pregnant women in relation to their IS use in the household.

Methods: A standard national sample: 30 schools (selected in proportion to enrollment size from the national list of primary schools, and 30 pupils randomly selected from all grades in each school. In addition, the field team visited the prenatal clinic located nearest to each school for enrolling a convenience sample of 3-12 pregnant women. Urine samples and a household salt sample were obtained for iodine analysis from each participant. The lab participates with the EUFOR veterinary exchange program.

Results: All the 1,297 household salt samples were iodized and the median iodine content was 14mg/Kg. Salt iodized at 12-15mg/Kg was used in 76% (95% CI: 67-72%) of the households and 52% (95% CI: 30-35) of the household salt samples were in 15mg iodine/kg. In 1994 school-age children, the median UI was 195µg/L; 9% (95% CI: 6-12) had UI <100µg/L. The median UI was 158µg/L in 147 pregnant women, 45% (95% CI: 40-51) of the women had UI <150µg/L in Serbia, pregnant women are commonly advised to use a dietary supplement. Among the 14% of women reporting to use a supplement, the median UI was 159µg/L, significantly (p<0.001) higher than the median UI of 146µg/L among women not using a supplement. No statistical relations were found between the iodine levels in household salt and the iodine status in either school-age children or pregnant women.

Conclusions: The salt supplier for human use in Serbia is fully iodized. While the iodine nutrition status of school children rests comfortably within the recommended range, pregnant women who are not using a dietary supplement have marginal iodine status. A modest upward adjustment of the mandated iodine level would ensure optimum iodine nutrition among all pregnant women in Serbia. To improve oversight, the Ministry of Health has re-established a National IDD Commission which is expected to advise on future policy steps.

TU19  LESSONS FROM SALT IODIZATION PROGRAMME MONITORING: TWO DECADES AFTER THE WORLD SUMMIT FOR CHILDREN

J. Untoro, J. Krasevec, A. Timmer, W. Schultink

Background: In 1990, during the World Summit for Children, 159 world leaders committed themselves to the virtual elimination of iodine deficiency disorders (IDD). Universal Salt Iodization (USI) has been adopted as a primary strategy to achieve the goal. To assess progress and achievement toward USI, WHO/UNICEF/ICCIDD have introduced 10 programmatic indicators in addition to indicators on household access to iodized salt and urinary iodine concentration at population level. Progress monitoring has been made within the last two decades with at least 34 countries having achieved USI and more than 50 countries on track to achieve USI by 2006 (UNICEF, 2008).

Aims: To review the programmatic indicators for monitoring the global progress and to identify key determinants of the success and failures in elimination of IDD through USI.

Methods: The 10 programmatic indicators (WHO/UNICEF/ICCIDD 2007) covering status regarding legislation, advocacy/communications, salt iodization supply, national coordination and monitoring were collected by UNICEF HQ from over 100 country offices in mid-2008. Based on the review and lessons from USI programme monitoring, progress of country programmes can be categorized into 4 categories in meeting the USI goal i.e. met the goal, on track, declining/lagging and those with low coverage/no progress. Multiple regressions and multivariate analysis of variance are used to find the determinants of salt iodization programmes.

Results: A preliminary analysis shows that one indicator essential to USI achievement is the status regarding legislation. By far the most common determinants were found to be: existence of national legislation and its enforcement (p<0.001, two tailed). The median iodine levels in salt and urine of pregnant women and children were closely correlated (p<0.001, two tailed) when analyzed by cluster. The median iodine levels in salt and urine were lower in Baku and its suburbs.

Conclusions: The experiences gained in more than two decades can be summarized in five key determinants to achieve and sustain progress i.e.: political commitment, national partnership and coaltion, availability (supply) of adequately iodized salt, a functioning monitoring system, advocacy and continuous communication to stakeholders.

TU20 IODINE DEFICIENCY DURING PREGNANCY IN RURAL BANGLADESH: EXTENT AND ASSOCIATION WITH IODIZED SALT USE

A. Akhmedov1, G. Ganiyeva1, I. Ramazanova1, G. Hadjiyeva1, G. Gerasimov3, D. Abbas2, J. Jarrakhova2, N. Umarov2, F. van der Haar4

Background:Iodine deficiency during pregnancy may increase risk of adverse pregnancy outcomes and impair mental development of offspring. Iodized salt offers a universal approach to control of iodine and its deficiency disorders (IDD).

Aims: We measured household salt iodine content and urinary iodine (UI) concentrations among pregnant Bangladeshi women in early (<16 weeks), n=718) and late (>32 weeks, n=1113) pregnancy during home visits to assess extent of deficiency and protection afforded by the use of iodized salt.

Methods: Data were collected within a sub-area of a large, double randomized, controlled trial, maternal vitamin A and beta-carotene supplementation in rural northwest Bangladesh from August, 2002 to February, 2007. One teaspoon (~5gm) of salt and ~10 ml samples of urine were collected, stored, transported and analyzed in Dhaka, Bangladesh. Salt was analyzed by ionometric titration method and urine using the Ohashi method.

Results: Participants were young (~20 years) and over one third were illiterate and less than half were involved with any earning activities. Mean (SD) weight at early and late pregnancy were 43 (6) and 48 (6) kg respectively. Practically all salt samples contained detectable iodine but ~3% contained less than 15 ppm of iodine. Median (UI) concentrations were 63 (7) and 56 (11) µg/L and iodine status remained insufficient (UI <150 µg/L) for 79% and 83% of women in the 1st and 3rd trimesters of pregnancy. Risk of iodine deficiency declined with increasing iodine content of household salt: median UI (UO) was at 56 (39-99) and 46 (24-84) µg/L, among women whom household salt was < 15 ppm, 17 (7-38) and 88 (60-141) µg/L for those whose salt was 15-19 ppm, and 188 (91-329) and 126 (62-246) µg/L for those whose salt was >20 ppm in early and late pregnancy, respectively.

Conclusions: Although Bangladesh has long adapted universal salt iodization, salt iodine content remains insufficient to assure adequate maternal iodine status through pregnancy in rural northern Bangladesh. With the strategy in place, greater emphasis on compliance can be expected to yield marked improvements in population iodine status. Direct iodine supplementation during pregnancy could be considered as another option during this high-risk period in life.

TU21 SUCCESSFUL ELIMINATION OF IODINE DEFICIENCY DISORDERS (IDD) IN AZERBAIJAN IS CHALLENGED BY LOW QUALITY OF LOCALLY PRODUCED IODIZED SALT

A. Aghayev1, G. Ramazanova1, H. Kumanda1, G. Akhmedov1, M. Naki1, Z. Karimova1, F. Adigezalova1, D. Abbas2, J. Jarrakhova2, N. Umarov2, F. van der Haar4

Background: In 2001 the Parliament of Azerbaijan passed a law on prevention of IDD, providing the legal basis for the establishment of a national program of IDD elimination through universal salt iodization (USI). The estimated annual demand for iodized salt for the 5 million Azerbaijan population is ~48 thousand MT/year. About half of the national salt supply are currently imported mainly from Turkey and Ukraine. The other half is supplied by small salt companies located around the Masazyr Lake in the northern suburbs of the capital Baku.

Aims: Assess the current status of iodine nutrition among the population in relation to the salt supplies and examine the progress toward the goal of IDD elimination.

Methods: A population representative iodine survey was conducted in Azerbaijan in May-June 2007, covering all the territory except Naxcivan Autonomous Republic. The design consisted of 30 clusters (schools) selected proportional to population and 30 children, aged 8-10y, selected at random in each school. The field teams also visited the prenatal clinic located nearest to each school to enroll ~10 consecutive pregnant women. In total, 932 children and 304 pregnant women participated and half of each supplied a household salt sample.

Results: The median iodine content in 558 salt samples was 22±10µg/kg, and 77% (95% CI: 73-80) of the salt contained ≥15mg iodine/kg. Median urinary iodine (UI) levels in school-age children (204µg/l) and pregnant women (195µg/l) were within the recommended safe range. The median UI in school-age children was closely correlated (p<0.001, two tailed) with the UI levels in their households. Also, the median UIs in pregnant women and in school children were closely correlated (p<0.001, two tailed) when analyzed by cluster. The median iodine levels in salt and urine were lower in Baku and its suburbs:

<table>
<thead>
<tr>
<th>Median Iodine Levels</th>
<th>Geographical Regions of Azerbaijan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt (mg/kg)</td>
<td>North-Mountain</td>
</tr>
<tr>
<td>Child (µg/kg)</td>
<td>27.5</td>
</tr>
</tbody>
</table>

Conclusions: Azerbaijan has successfully eliminated iodine deficiency by an effective national program and enforcement of the USI law. Notwithstanding the quick successes, significant quality problems remain with domestically produced iodized salt, which is likely to affect the program’s sustainability in a negative way. Policy priority should be given to assist the small salt companies near the Masazyr Lake in efforts to improve their salt iodization practices.

Tuesday, 12 May, 2009

Iodine and Universal Salt Iodization
**TU22**

**TOOLS TO IMPROVE MONITORING, COMPLIANCE AND PROFITABILITY OF SMALL SALT PRODUCERS IN SENEGAL**

1. Ideye, B. Ideye, A. Miltoff, D. N. Touré, B. Ideye

**Background:** Despite a government ban on non-iodized salt production, more than 10,000 small-scale producers with little or no capacity for salt iodization continue to supply the market resulting in only 64% of households consuming iodized salt. Many producers report willingness to iodize their salt but only if they can be assured of adequate financial returns. Their ability to use potassium iodate efficiently to produce iodized salt that commands a higher price is key.

**Aims:** The aim was to introduce simple quality assurance procedures that engage the (often illiterate) producers in assessing salt iodization levels during processing to encourage their wider compliance with salt iodization legislation.

**Methods:** As well as salt iodization machines, internal quality assurance and production tools (QA-P) and training on their use were provided to associations of producers called GIEs. QA-P reports help track iodized salt production quality and quantity, and collect information such as iodate and fuel usage, production quantities and proper machinery function. The results of QA-P tracking information can be corroborated by producers’ observation of KIO3 use, fuel inputs and rapid salt test results, and can be used by them to trigger procurement of new inputs. GIE community workers regularly gather QA-P data and refer to salt extenders who provide day-to-day guidance. Regular meetings were held with GIEs to assess progress and identify and resolve issues.

**Results:** The financial management and profitability of the GIE salt business improved due to better accounting for total salt production, increased transparency among GIE group members and more consistent salt quality (99.77% iodized salt content) for 22,441,000 person years of coverage. Increased memberships of the GIs resulting to 61% monthly production increase from July 2007 to July 2008. The improved capacity on the part of GIE members for forecasting their needs improved their ability to access inputs such as potassium iodate consistently (zero KIO3 shortage reported). The improved monitoring of iodized salt production based on regular QA-P reporting by GIEs who received salt iodization machines enabled them to comply with salt iodization standards (and avoid problems with government regulators). Local government agency reports increased proportion of rapid test results complying to government standards over time.

**Conclusions:** The utilization of comprehensive but simple and user-friendly QA-P tools contributed to improved compliance of small salt producers by increasing both their profitability and production management capacity.

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**TU23**

**THE PERFORMANCE OF RAPID SALT IODINE TESTS TO ASSESS THE COVERAGE OF IODIZED SALT IN LARGE-SCALE SURVEYS**

F. Bonneau1, F. Bonneau2, N. Thesis3, B. Thevet1

**Background:** Regular knowledge of the supplies and consumption of iodized salt is a critical part of salt iodization monitoring. Often, national household surveys such as MICS and DHS include rapid “on-the-spot” tests of household salt, and rapid tests of salt iodine are also frequently part of special population-based IDD surveys. Laboratory studies of the performance of rapid tests have led to a consensus that they can be used reliably for a coverage estimate of iodized salt (whether salt is iodized or not), but not adequately iodized salt (whether salt is iodized above a certain content or not).

**Aims:** Explore whether the performance of rapid salt iodine tests in large-scale surveys is in agreement with the consensus from laboratory studies.

**Methods:** Ten datasets, which included salt iodine contents from both rapid test readings and from quantitative measurements in a laboratory, were obtained from surveys conducted in 2003 and 2004 in East Asia, Central Asia and East Africa. The diagnostic screening indicators sensitivity (Se) and specificity (Sp) were used to derive positive (PPV) and negative predictive values (NPV) for comparing the predictive test ability across surveys. We used the accuracy, or agreement rate (AR), as preferred overall indicator of test performance. Primary school were the basic sampling units in three surveys and households in seven. Laboratory measurements of the salt iodine content were performed by standard titration in seven surveys, and by the WHO Checkers in three. In four surveys, binary codes were used for recording the presence or absence of iodine, thus permitting an assessment of the test performance for iodized salt only. Some introductory training in the use of the rapid test kit took place in all the surveys, but follow-up or feed-back of experiences from field teams to their supervisors were not standard practice.

**Results:** In tests for iodized salt, the AR attained ≥90% in four surveys but in tests for adequately iodized salt always requires taking a salt sub-sample for quantitative salt iodine measurements. Robust coverage estimates for iodized or adequately iodized salt can only be obtained if two conditions are both met, namely (a) the AR between rapid test readings; and quantitative assays should be at least 90%; and (b) the difference between false negative and false positive readings should be minimal. To ensure these conditions, two approaches include (a) standardization training of field teams prior to surveys; and (b) improved supervision of the teams during surveys.

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**TU24**

**GESTATIONAL IODINE DEFICIENCY (ID) AND NEUROPSYCHOLOGICAL DEVELOPMENT OF CHILDREN AT FIVE YEARS OF AGE IN RURAL BANGLADESH—CATEGORIZATION OF GESTATIONAL IODINE STATUS BY MULTIPLE INDICATORS**


**Methods:** Possible long-term effects of mild to moderate iodine deficiency during pregnancy on cognitive/motor function of children are unclear. In order to investigate this potential association, maternal iodine status during pregnancy has to be fully categorized first. This project will evaluate the impact of mild to moderate gestational ID on child neurodevelopmental at 5 years of age in rural Bangladesh. The first step of this project is to fully categorize gestational iodine status of mothers of these children using multiple indicators.

**Aims:** 207 mothers of children whose neuropsychological development will be assessed at 5 years of age participated in a substudy of a vitamin A and folic acid supplementation trial in Bangladesh between 2003 and 2005. Gestational iodine status of these mothers is measured by indicators of Urinary Iodine Excretion (UIE), serum thyroglobulin (Tg) and free thyroxine (FT4) during the 1st (~9 weeks gestation) and 3rd trimesters (TM) (~30 weeks gestation). The relationship between UIE and FT4/Tg will be checked using scatter plot during 1st and 3rd TM, respectively. Furthermore, FT4/Tg will be compared between those groups which are categorized by UIE (Moderate: 20–49 μg/L, mild: 10–49 μg/L, adequate: UIE >100 μg/L) during 1st and 3rd TM, respectively.

**Results:** Mild to moderate iodine deficiency is endemic in rural Bangladesh. Data on gestational iodine status of 207 mothers using 3 multiple indicators (UIE, Tg, and FT4) at 1st and 3rd TM are being analyzed and will be presented in May, 2009.

**Conclusions:** Categorization of gestational iodine status by multiple indicators will minimize possible misclassification bias by UIE at the individual level and thus will provide us valid estimation of maternal iodine status during pregnancy. Consequently, full categorization of gestation iodine status will contribute to the quality of the full study which will provide age-controlled current evidence of possible long-term effects of gestational iodine deficiency on child neurodevelopmental. In doing so, the findings could stimulate renewed efforts to achieve adequate iodine status among women of reproductive age and highlight a potential need to supplement pregnant women with iodine to reduce risks of cognitive/motor impairment of children.

Funded by a DSM Scholarship for International Micronutrient Research, the Sight and Life Research Institute, Baltimore, MD and the Bill and Melinda Gates Foundation, Seattle, WA.
TU25

NIGHT BLINDNESS AMONGST PREGNANT WOMEN IN A RURAL BLOCK OF UTTARANCHAL STATE, INDIA

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1Al India Institute of Medical Sciences, New Delhi, India; 2College of Home Science, GB Pant University of Agriculture and Technology, Pantnagar, India

Introduction: Vitamin A deficiency (VAD) increases morbidity and mortality during pregnancy and early post partum period in women of reproductive age. Night blindness is recommended as a population-based indicator of vitamin A deficiency. Limited data is available on prevalence of VAD utilizing this indicator amongst pregnant women of Uttarakhand State, India. Hence the present study was undertaken to assess the same.

Methods: A community based cross-sectional survey was conducted in a rural block of district Udham Singh Nagar, Uttarakhand, India. Sixteen villages were randomly selected. All pregnant women residing in these villages were enrolled. The data on socio-demographic parameters, anthropometric measurements of weight and height, and obstetric history was collected utilizing a pre-tested semi-structured questionnaire. Any pregnant women reporting inability to see in dim light, problems in undertaking regular household activities during night, specifically during early mornings and late evenings were judged as night-blind women, indicating VAD. Maternal data was assessed by the 24-h dietary recall method. Data collected was subjected to statistical tests utilizing SPSS 11.0 Software.

Results: A total of 351 pregnant women were enrolled. Ten percent (n=35) of the pregnant women were suffering from VAD. Multivariate logistic regression analysis revealed that young women (age < 19 years) were at a 2.54 times higher risk of suffering from VAD compared to women aged more than 19 years (p = 0.01). Data on dietary intake revealed that 81.4 percent of the women were consuming vitamin A less than 50 percent of recommended dietary allowance. Women with night blindness had a lower intake of vitamin A as compared to the other women (381.82 vs 914.16 IU/day).

Conclusions: The present study revealed that 10% of pregnant women had VAD in the area studied, possibly due to poor dietary intake of vitamin A. There is a need for nutritional counseling for the pregnant women of the area studied to improve their vitamin A status.

TU26

THE INFLUENCE OF MATERNAL FACTORS ON THE CONCENTRATION OF VITAMIN A IN MATURE BREAST MILK

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A community based cross-sectional survey was conducted in a rural block of district Udham Singh Nagar, Uttarakhand, India. Sixteen villages were randomly selected. All pregnant women residing in these villages were enrolled. The data on socio-demographic parameters, anthropometric measurements of weight and height, and obstetric history was collected utilizing a pre-tested semi-structured questionnaire. Any pregnant women reporting inability to see in dim light, problems in undertaking regular household activities during night, specifically during early mornings and late evenings were judged as night-blind women, indicating VAD. Maternal data was assessed by the 24-h dietary recall method. Data collected was subjected to statistical tests utilizing SPSS 11.0 Software.

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Conclusions: The present study revealed that 10% of pregnant women had VAD in the area studied, possibly due to poor dietary intake of vitamin A. There is a need for nutritional counseling for the pregnant women of the area studied to improve their vitamin A status.

TU27

SUCCESSFUL IMPLEMENTATION OF THE NATIONAL VITAMIN A SUPPLEMENTATION PROGRAM CONTRIBUTED TO IMPROVED CHILD SURVIVAL IN NIGER FROM 2000 TO 2006

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1Sector Development Strategies Inc., Bozeman, Massachusetts, United States; 2UNICEF, Nairi, Niger; 3Ministry of Health, Nairi, Niger, Helen Keller International, Dakar, Senegal; 4UNICEF, New Delhi, India

Background: Vitamin A supplementation is widely recognized as a high-impact and cost-effective component of child survival programs in countries where vitamin A deficiency is prevalent and under-five mortality rates are high.

Objective: To examine the likelihood that the national vitamin A supplementation program in Niger made a substantial contribution to the 29% reduction in under-five mortality observed between 2000 and 2006, a time period in which the supplementation program consistently achieved ≥80% coverage among 6-59 month old children by distributing vitamin A supplements, twice a year, in conjunction with National Immunization Days for polio or during National Micronutrient Days.

Methods: We used a plausibility analysis framework and quantitative data from two nationally representative household-based surveys: sampled collected in 2000 (Multiple Indicator Cluster Survey) and 2006 (Demographic and Health Survey) to examine the relationship between vitamin A supplementation coverage and infant, child and under-five mortality rates.

Results: In 2000, there was no apparent association between regional-level vitamin A supplementation coverage and under-five mortality rates. In 2006, an effective relationship was observed in 2006 after the program had been operating at full-scale for more than five years. Although certain other health indicators improved, vitamin A supplementation was the only one included in the international Child Survival Countdown to 2015 to be ‘on track’ and achieving effective levels of coverage. No evidence was found to suggest that general improvements in living conditions or the expansion of other health programs alone could have accounted for larger reductions in under-five mortality.

Conclusions: These findings suggest that the national vitamin A supplementation program made a substantial contribution to improved child survival in Niger and further confirm the centrality of regular vitamin A supplementation for child survival in settings where - like in Niger - vitamin A deficiency and under-five mortality are high.
**Vitamin A Deficiency and Vitamin A Supplementation Interventions**

**TU29**

**SUCCESS AND FAILURE OF BAL SAVJUVI/VI: A BI-ANNUAL DRIVE TO ACCELERATE VITAMIN A SUPPLEMENTATION AND NUTRITION OUTCOMES FOR CHILDREN IN MADHYA PRADESH, INDIA**

U. Agarwal, V. Agarwal, A. Upadhyay

**Background:** The success and failure of bi-annual drives to accelerate vitamin A supplementation and nutrition outcomes for children in Madhya Pradesh, India, are among the highest in India. Building on the infrastructure of the Integrated Child Development Services (ICDS) program, the government of MP initiated with UNICEF to support the Bal Savjivani drive, a month-long bi-annual acceleration initiative to deliver an integrated package of essential health and nutrition services for children 0-59 months old.

**Aims:** To carry out a bi-annual large scale growth monitoring drive and provide pre-school age children with vitamin A supplementation and immunizations as per national guidelines.

**Framework:** A strong alliance was established between the Government of Madhya Pradesh and its development partners. The strategies used included intensive advocacy and awareness generation, decentralized planning and service convergence, capacity building of field workers through various means including satellite-based communication system, and an action-oriented user-friendly monitoring system. Outcomes: The biannual drive has been conducted in all the 334 blocks of the state. A total of 78,300 health and nutrition frontline workers have been trained and supervised. 1.2 million children under five years old have been reached. Vitamin A supplementation coverage has increased from 2% in 2001 to 69% in 2007. These positive results have motivated the government of Madhya Pradesh to integrate deworming for all children 1 to 5 years old with vitamin A supplementation starting in 2008. Importantly, the entire supply of vitamin A supplements and deworming tablets is now being procured by the state government with no support from UNICEF. Despite large scale growth monitoring, the lack of a comprehensive strategy to prevent and reduce child undernutrition translated into insignificant improvements in the nutritional (anthropometrical) status of children. Similarly, sub-optimal convergence between the departments of Health and Family Welfare and the Department of Women and Child Development resulted in failure to improve immunization rates.

**Implications:** On the basis of these results, UNICEF will continue to support Government of Madhya Pradesh in consolidating the gains on VAS and deworming while expanding biannual coverage to un reach children, particularly those from poorer and socially excluded families.

**TU31**

**VITAMIN A SUPPLEMENTATION AT BIRTH AFFECTS MORTALITY AFTER VITAMIN A SUPPLEMENTATION AFTER 12 MONTHS OF AGE**

A. Aguayo, P. Kaly, E. Owen

**Background:** There is increasing evidence that early administration of vitamin A may reduce mortality, but the extent to which this effect persists with continued supplementation is not well understood. The Bandim Health Project in Guinea-Bissau randomized newborns to receive VAS (50,000 IU) or placebo with BCG vaccine. After 12 months of age all trial children were visited and offered VAS (100,000 IU). Some children were not found at home or were found at an older age. Using Cox models stratified by sex, we compared survival following receipt of VAS after 12 months of age for children who had received VAS at birth and placebo at birth. Further, we compared survival by sex and receipt of VAS at birth, we compared mortality between 12 and 36 months of age in those who received VAS after 12 months of age with those who had not (yet) received VAS.

**Methods:** The Bandim Health Project in Guinea-Bissau had randomized newborns to receive VAS (50,000 IU) or placebo with BCG vaccine. After 12 months of age all trial children were visited and offered VAS (100,000 IU). Some children were not found at home or were found at an older age. Using Cox models stratified by sex, we compared survival following receipt of VAS after 12 months of age for children who had received VAS at birth and placebo at birth. Further, we compared survival by sex and receipt of VAS at birth, we compared mortality between 12 and 36 months of age in those who received VAS after 12 months of age with those who had not (yet) received VAS.

**Results:** Of the 4,345 children enrolled at birth, 3,090 were still living in the study area at the 12 months visit and 3002 were supplemented. There were 110 deaths in the 2nd and 3rd year of life; 61 among children who had received VAS after 12 months of age. Among children who received VAS after 12 months of age, the mortality rates (MMR) was 0.53 (0.33,0.92) for those who had received BCG and VAS at birth compared with recipients of BCG and placebo. This effect may have been stronger for girls (0.37 (0.16,0.88)) than boys (0.69 (0.37,1.43)). Stratified by sex and VAS at birth, girls benefited from VAS after 12 months of age if they had BCG with VAS at birth (0.19 (0.07,0.50)) but not if the had received placebo at birth (0.96 (0.42,2.22)) (p for interaction 0.01). For boys the effect of VAS after 12 months of age was similar whether they had received VAS (1.38 (0.44,4.33)) or placebo (0.94 (0.40,1.86) (p for interaction 0.59). These sex-differences were reflected in a significant interaction between sex, VAS at birth and VAS after 12 months of age (p=0.04).

**Conclusion:** The present results suggest that VAS at birth primes the response to subsequent VAS, particularly in girls. If the response to VAS depends on prior doses it may be one of the factors explaining the varying effect of VAS.
Child Health and Nutrition Months Significantly Improve Vitamin A Supplementation Coverage in Uttar Pradesh, India

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Background: Uttar Pradesh (UP), the most populous state in India with 190 million people, accounts for 21% of the under-five population of the country and 36% of total under-five deaths. Interventions for improving child nutrition namely optimal infant and young child feeding practices and improved micronutrient nutrition and anemia control have significant impact on child survival, growth, and development. Control of vitamin A deficiency is a national programme, which aims at protecting children 6-59 months through administration of a single emergency dose of vitamin A at six monthly intervals. Despite the policy, program coverage has been low giving rise to a need to develop and implement alternate approaches for improving delivery. Biannual child health and nutrition months targeted at the provision of a comprehensive package of health and nutrition services including vitamin A supplementation linked to routine immunization outreach sessions is one such approach adopted in the state.

Aims: The aim of the biannual child health and nutrition months is to improve access to and coverage of a comprehensive package of services for children below five years, which includes vitamin A supplementation, growth monitoring, promotion of adequate infant and young child feeding practices, and screening and referral of undernourished children.

Methods: The program started in one district in 2000; by the year 2005 the program was covering 18 districts (26% of state districts) and reached state-wide scope in 2006. The strategic focus was on improving interdepartmental coordination, enhancing the capacity of health and nutrition functionaries, mobilizing civil society, generating community demand, ensuring supply logistics, and improving monitoring and supervision. Outcomes: The programme has contributed to (i) increase vitamin A supplementation coverage from 9% to 43% in infants 6-11 months old and from nil to 37% for children 12-59 months old, (ii) use of adequately iodised salt as part of an integrated package of essential health and nutrition interventions for children. Government of UP has endorsed the approach and integrated it into the state plans of action for Health and Nutrition. Assuring supply chain and consumption of adequately iodised salt are key aspects of the approach.

Results: Total 260 children (48.5% were female, 50% had oedema, all had diarrhea and 54% had concomitant ALRTI), with a mean±SD age of 16±10 months were studied. Children of the two groups did not differ at baseline in any of the nutritional, demographic, socio-economic, and medical characteristics. Over the 15 days treatment period outcomes in terms of resolution of diarrhea, ALRTI and oedema were similar between the groups. Three children died, and all received high-dose VA. The following table shows important biochemical values related to vitamin A.

<table>
<thead>
<tr>
<th>Baseline (serum)</th>
<th>Low-dose</th>
<th>High-dose</th>
<th>Effect</th>
<th>Low-dose (median)</th>
<th>High-dose (median)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retinol (ng/mL)</td>
<td>13.6 ± 9.5</td>
<td>13.3 ± 9.1</td>
<td>0.024</td>
<td>9.50</td>
<td>9.80</td>
</tr>
<tr>
<td>RBP (mg/dL)</td>
<td>1.20 ± 0.9</td>
<td>1.26 ± 0.9</td>
<td>0.060</td>
<td>1.00</td>
<td>0.92</td>
</tr>
<tr>
<td>Prealbumin (mg/dL)</td>
<td>8.3 ± 3.9</td>
<td>7.6 ± 3.9</td>
<td>0.072</td>
<td>27.50</td>
<td>26.20</td>
</tr>
<tr>
<td>C-reactive protein (mg/L)</td>
<td>7.5 (median)</td>
<td>9.7 (median)</td>
<td>0.050</td>
<td>2.60</td>
<td>2.51</td>
</tr>
</tbody>
</table>

Conclusion: Efficacy of daily low-dose vitamin A is comparable to initial high-dose vitamin A followed by daily low-dose in the management of severely maldnourished children with acute illnesses. Outcome of treatment was similar in both groups.
**TU35**

**THE EFFECT OF HIGH-DOSE VITAMIN A SUPPLEMENTATION ADMINISTERED WITH BCG VACCINE AT BIRTH MAY BE MODIFIED BY SUBSEQUENT DTP VACCINATION**

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**Background:** Unexpectedly, we found no overall beneficial effect on mortality in a randomised trial of vitamin A supplementation (VAS) or placebo administered with BCG vaccine at birth in Guinea-Bissau. However, the survival curves indicated a non-differential negative effect of VAS in girls after the first months of life.

**Aims:** We conducted an explorative analysis to examine whether subsequent diphtheria-tetanus-pertussis (DTP) vaccinations had modified the effect of VAS.

**Methods:** Mothers were invited to participate when their child was to receive BCG vaccine after delivery. The children were randomised to 50,000 IU vitamin A or placebo. All children were followed to age 12 months through a demographic registration system. Vaccine information was obtained from all health clinics in the study area and from 1-monthly home visits. Data was analysed in Cox models. Main outcome measures were mortality rate ratios (MRRs) for VAS compared with placebo recipients. The study was registered under clinicaltrials.gov, number NCT00169579.

**Results:** A total of 4345 children were enrolled, and 174 died within the first year. As long as the children had BCG vaccine as their last vaccine, the VAS-placebo MRR was 0.86 (95 % CI: 0.48 to 1.54), 0.89 (0.42 to 1.88) in boys and 0.82 (0.32 to 2.88) in girls. After the children received DTP vaccine, the VAS-placebo MRR was 1.43 (0.88 to 2.32), 0.90 (0.44 to 1.90) in boys and 2.19 (1.09 to 4.38) in girls.

**Conclusions:** VAS at birth was associated with a weak tendency for decreased mortality as long as BCG was the last vaccination. However, after DTP vaccination girls who had received VAS at birth had increased mortality. So far five trials of neonatal VAS have been conducted; three trials found beneficial effects on mortality whereas two trials did not. It has been proposed that the explanation for the divergent results is differences in the degree of vitamin A deficiency and baseline mortality but this explanation does not fit the existing data. Differences in DTP vaccination intensity between the five trials may better explain the divergent results; VAS being beneficial in areas with low DTP vaccination intensity but potentially harmful for girls in areas with high intensity.

**TU36**

**THE EFFECT ON EARLY GROWTH OF PROVIDING VITAMIN A SUPPLEMENTATION WITH BCG VACCINE AT BIRTH TO LOW BIRTH WEIGHT INFANTS IN GUINEA-BISSAU**

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**Background:** Low birth weight (LBW) infants constitute one of the largest high-risk groups in low-income countries. Impaired growth among children is associated with an increase in mortality. Observational studies have shown that vitamin A deficiency impairs childhood growth, but the effect of vitamin A supplementation (VAS) on childhood growth has been conflicting in randomized trials.

**Methods:** Childhood vaccinations might also affect the growth among LBW infants. According to current policy, LBW infants receive oral polio vaccine (OPV) at birth and Bacille Calmette-Guérin (BCG) vaccine 6 weeks later. However, receiving BCG at birth may be associated with improved growth especially among LBW girls.

**Aims:** To examine in a randomized two-by-two factorial trial the effect on growth of 15,000 IU vitamin A and BCG vaccine given at birth to LBW infants in Guinea-Bissau.

**Methods:** The trial was conducted at the Bandim Health Project in Guinea-Bissau. From November 2004 to February 2008, LBW infants delivered at the national hospital or coming for the first vaccination at three local health centers in the study area of the Bandim Health Project were invited to participate in the study. In total, 1,868 LBW infants were randomized to early or the usual delayed BCG and among them 1,622 were randomized to 15,000 IU vitamin A or placebo at enrolment in a two-by-two factorial design. Weight, length, mean upper arm circumference as well as head and abdominal circumference were measured by trained field assistants at enrolment, and at 2, 6 and 12 months of age.

**Results:** Statistical analyses are ongoing and preliminary results will be presented at the meeting.

**Conclusions:** The results from this study may help to determine which early interventions can improve growth among one of the largest high-risk groups in low-income countries.

**TU37**

**BREASTMILK RETINOL OF FILIPINO LACTATING WOMEN AND THE VITAMIN A STATUS OF THEIR BREAST-FED INFANTS**

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**Background:** Vitamin A deficiency (VAD) among Filipino lactating women has been reported as a significant public health problem in the 1987, 1993, 1998 and 2003 National Nutrition Survey (NNS). To alleviate the problem, an Administrative Order for the administration of 200,000 IU vitamin A (VA) was passed. Breastmilk (BM) vitamin A is recommended by the World Health Organization (WHO) for monitoring vitamin A status of lactating women and infants.

**Objectives:** Using 2003 NNS data, this paper aimed to: (1) determine the BM retinol levels of Filipino lactating women (2) to assess the vitamin A status of breast-fed infants in relation to maternal BM retinol levels (3) to determine BM retinol levels of lactating women who received 200,000 IU VA and other supplements.

**Methods:** Casual BM samples were collected from women, 3 wks to 1 mos of lactation. Blood samples were collected from lactating women and their infants by capillary method. BM and plasma retinol levels were determined by high-pressure liquid chromatography (HPLC). The fat content of BM samples was determined by creamatocrit method. BM retinol concentrations <0.25 µmol/L or <10 µg/dL were considered indicative of low BM vitamin A. Plasma retinol concentrations <0.70 µmol/L were considered indicative of VAD, both in women and infants.

**Results:** BM retinol concentrations were highest in women at first 3 months of lactation (1.10 ± 0.09 µmol/L) and remained constant at 4-6, 7 and 10-11 months (0.92 ± 0.06, 0.98 ± 0.06, 1.00 ± 0.08 µmol/L, respectively). Although the mean BM retinol levels are high, prevalence of low values from Filipino lactating women showed a severe public health problem (>25%) across stages of lactation. Breast-fed infants whose mothers had BM retinol levels >0.8 µg/dL showed significantly higher plasma retinol concentrations (0.84 ± 0.05 µmol/L than those whose mothers had BM retinol levels <0.8 µg/dL (0.67 ± 0.038 µmol/L). Lower BM retinol prevalence rates were observed in infants whose mothers had normal BM retinol levels (18%) compared with those whose mothers had low BM retinol levels (50%). BM retinol levels of mothers who received high dose VA and other supplements were higher than those who did not receive any.

**Conclusions and Recommendation:** Low BM retinol levels among Filipino lactating women showed a severe public health problem. The low levels of BM vitamin A are sufficient for basal needs only for the first 9 months of the lactating infant. Results showed that giving VA to lactating women is beneficial to the mother and their infants; thus implementation of this program should be intensified.

**TU38**

**LESSONS LEARNED FROM EARLY IMPLEMENTATION OF NEONATAL VITAMIN A DOSING IN NEPAL**

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**Background:** Nepal has made considerable progress in reducing child mortality. An important contribution in this effort has come from Nepal’s 50,000 Female Community Health Volunteers (FCHVs), based in every village of the country and able to achieve high population coverage with key health promotion and community-based distribution functions. In most districts of the country they provide antenatal counselling and dispense key commodities (notably iron supplements). In a few districts they are also routinely making early post-natal home visits. FCHVs now give considerable attention to neonatal (NN) health. Large trials in India and Bangladesh have established that, at least in a South Asian setting, dosing newborns with 50 µg of vitamin A can reduce mortality.

**Intervention:** On the strength of the evidence on NN dosing, the Nepal MoH decided to proceed with phase 1 public sector piloting in 4 of Nepal’s 73 districts – 2 in the southern plains area and 2 in the hill/mountain area. The approach has been to use multiple channels to reach NNs with vitamin A. In all 4 districts, NNs born in 1HF are given vitamin A before discharge. At community level 2 different modalities are used. In 2 of the 4 districts (1 plains, 1 hills), FCHVs provide both antenatal counselling and early post-natal home visits; in these districts vitamin A has been dispensed to pregnant women late in pregnancy with instructions on its use and, at the time of postnatal visit, dosing is confirmed and, if not already given, the FCHV does the baby. In the other 2 districts (1 plains, 1 hills) FCHVs give antenatal contact but have not been doing post-natal home visits. In those districts, FCHVs dispense late in pregnancy but do not follow up post-delivery.

**Results:** The presentation will describe the roll-out process, including monitoring provisions, and will present early results.

**Discussion:** Successes, challenges and potential for rapid scale-up will be discussed. The strengths of Nepal’s approach to community-based dispensing and service delivery will be described, drawing lessons for other country settings.
TU39 IMPROVING VITAMIN A SUPPLEMENTATION (VAS) IN SIX EASTERN DISTRICTS OF UTTAR PRADESH STATE, INDIA BY ADDRESSING BARRIERS OF HIGH COVERAGE BY IMPROVING GOVERNMENT PROCESSES

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**Background:** Six monthly (biannual) supplementation of Vitamin A mega dose (200000 IU) for children aged 1-5 years is recommended policy of Indian government as there are evidences of reduction in under five mortality (USMR) by 25% with vitamin A supplementation. Keeping this in view biannual Vitamin A supplementation strategy is adopted by UP government to improve the Vitamin A coverage in state. A2Z (UPMR micronutrient program) is supporting biannual VAS program named Bal Swastha Poshan Mah (BSPM - Child Health and Nutrition month) since June, 2006. The early days of program identified important program needs and barriers in high coverage of VAS. In subsequent programs in 2006-8 A2Z has systematically worked with government mechanism to address the major need that is inaccuracy of certain target population size in the available data.

**Aims:** Streamlining recording, reporting and analysis of data related to VAS based on estimated population based targets.

**Methods:** A2Z has helped states to identify population gap, calculate denominator for state, district and block for Vitamin A supplementation, Vitamin A bottles requirement and its distribution plan and analysis for each BSPM round for assessing coverage reported against targets set.

**Results:** In 2007 State wide population based targets for VAS has been released for the first time for all 70 districts of UP. More children were (46 to 62.7%) identified for VAS in place of expected 60.6% increase in base after change in age group for VAS from 9-36 months to 9-59 months. The result also showed reduced gap in expected and reported target children of expected 40.6% increase in base after change in age group for VAS from 9-36 months to 9-59 months. The result also showed reduced gap in expected and reported target children for VAS from 30-50% in December 2006 to only 3-5% in December 2007.

**Conclusion:** Inaccuracy of target population size could be corrected by systematically reviewing targets and identifying population gaps at all levels. Supply monitoring of Vitamin A bottles at each level ensures accurate reporting and 100% report generation from field (sub centre level) ensures accuracy in annual report at higher level.

Lessons learnt at these exercise shared with the state ended up for similar accurate target setting for all 71 districts in current year. This greatly facilitated supply of exact requirements and would also facilitate accurately estimation of coverage rates.

TU40 CHALLENGE OF ADDRESSING VITAMIN A DEFICIENCY IN INDIA

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Although Vitamin A supplementation programme has been implemented since 1976 throughout India, recent studies using prevalence of night blindness as the indicator for vitamin A deficiency indicate a prevalence ranging from 6.6% to 10.1%. The WHO standard of 0.5% per cent prevalence of Bitot's spots has also been exceeded. This has resulted in reversal of the national policy in 2006, with Vitamin A supplementation being advocated for all children up to five years of age instead of just three years of age. The goals of the country's development plan include decreasing the prevalence of vitamin A deficiency to 0.3%. The strategy adopted to achieve this goal includes promotion of infant and young child feeding, health education efforts to ensure adequate intake of Vitamin A rich food throughout childhood, early detection and prompt treatment of infections, management of xerophthalmia and Vitamin A supplementation with nine doses, six months apart, for all children between the ages 9 months to five years with additional supplementation for children with malnutrition and those recovering from measles. A monthly Health and Nutrition Day now gets conducted in each village throughout the country. Vitamin A supplementation, nutrition counseling and clinical examination for detection of signs of vitamin A deficiency form an integral part of the broader range of maternal and child health services provided. The policy of giving biannual "Child Nutrition Month", six months apart, has been introduced by states, notably those with the higher levels of malnutrition. Active management for malnutrition including treatment of malnutrition deficiencies, nutrition counseling with breastfeeding promotion as a central component, and iron folic acid and vitamin A supplementation at Nutrition Rehabilitation Centres has been initiated and as more of these become functional, the focus is moving towards consolidation of the gains made in malnutrition management. The supplementation coverage levels have improved from 5% and 29% to 107.5% and 58.9% for the first and subsequent doses respectively. Given the magnitude and scale of the extent of the problem of clinical Vitamin A deficiency in India fortification of widely consumed food products has been explored. It is mandatory for vanaspati (a widely used cooking fat of vegetable origin) to be fortified with vitamin A to a level of 400 IU of the RSA and fortification of milk with Vitamin A is being considered.

TU41 EXTERNAL CHANGE AGENTS ENABLE DISTRICT HEALTH SYSTEMS TO IMPROVE VITAMIN A SUPPLEMENTATION PROGRAM PROCESSES AND COVERAGE SIGNIFICANTLY IN SIX STATES OF INDIA

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**Background:** The Vitamin A Supplementation (VAS) program in India is characterized by poor planning, supply shortfalls, low capacity & lack of awareness, resulting in low coverage. The NR-UNICEF joint country assessment of VAS program in 2004, recommended the use of district extenders (DEs), as successfully demonstrated by the national TB program. A DE works with 4-5 districts as an external change agent; building capacities & strengthening systems to achieve & maintain high coverage. S/he usually holds a master's degree, is trained on technical & managerial issues upon induction & enabled for communication & travel to field areas. MI has supported 4 NGOs to recruit, train & support the DEs in 6 states since 2005.

**Aims:** To help district extenders in the existing program address, (i) to build their capacity to plan, implement & monitor the VAS program well in the future.

**Methods:** Process indicators are tracked from external (96-08). Number of VA doses provided was analyzed based on reports from state governments, UNICEF & MI state offices.

**Results:** In 07-08, 33 extenders were supporting 154 districts in the 6 states. VA doses given to pre-school children in these 6 states went up from 21.8 million in 03-04 to 45.7 million in 06-07, an increase of 78% over 3 years. Process indicators from 5 states, also point towards substantial progress: 92% of district health officers were met every month by DE, WHO primary health centres & 95% VAS sites were visited for monitoring & supervision. Of children investigated during field visits, 84% (n=7232) reportedly received a VA dose in the last 6 months. The Vitamin A supply status was known for 95% of districts throughout the year. On average, a DE helped conduct 1.76 training/IEC activities per district every month. Presence of DEs improved quality & timeliness of reported data. An external evaluation of the model planned in 2009 which will assess impact on processes & coverage.

**Conclusions:** The DE model has been able to positively influence program processes. The increases in VAS doses delivered in the 6 states could be attributable at least in part, to these change agents’ support at district level. The proposed evaluation will confirm the factors critical for success & replication of the model in other areas but comprehensive training, better communication & the ability to cut across government hierarchy appear important. The sustainability of high coverage, if & when DEs are withdrawn, will also need to be probed, but it is hoped that capacity building of district health systems by the DE model will have a long term sustainable impact.

TU42 MAJOR CHALLENGES IN ELIMINATING VITAMIN A DEFICIENCY AND SUSTAINING HIGH VITAMIN A SUPPLEMENTATION COVERAGE IN THE PHILIPPINES

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**Background:** Vitamin A deficiency (VAD) is a major public health problem, causing blindness among children in the past. While xerophthalmia is rarely seen now, VAD remains a public health problem. VAD supplementation (VAS) started on a pilot basis in 1988 focusing on high risk children. Universal VAS was started in 1993 for under five year olds, achieving high coverage at 95% during the nationwide Micronutrient Supplementation Days Campaign in 1995. This high coverage was not sustained in succeeding years as the excitement of the campaigns waned. VAS was also incorporated during national immunization days, and during the 10-year Measles Elimination Campaign which started in 1996. In 1999, the Preambulers week, a biannual campaign every April and October became the regular vehicle for universal VAS. This heralded new interest for VAS with increasing coverage. This campaign is regularly conducted until now with target set at 90% coverage. Coverage of vitamin A supplementation from 1999 to 2005 were both an average of the 83.1% for the first dose and 84 % for the second dose, and 2006 – 2008 ranging from 86 to 76 %. The highest coverage was at 93% in 2004-05.

Since vitamin A supply is programmed based on complete coverage of preschool children but coverage has not reached the 95% target. Major issues and problems in sustaining VAS coverage are insufficient VA capsules (VAC) supplies, migratory population, armed conflict situation, hard to reach populations, unmarked population in urban depressed areas. Several delivery approaches were used to reach the target beneficiaries, such as through health facilities and temporary VAS posts, house to house as well as door-to-door provision of VAC. VAC supplies is procured by the government through UNICEF system but the shift from this system to local procurement because of this year’s major bottlenecks. A recent local study showed that even with twice a year VAS fails to maintain serum retinol for 6 months. Major efforts include lobbying for increase funds for VAC procurement, streamlining the delivery system, monitoring and program reviews, micronutrient guidelines development. Emergency requests for VAC donations to bridge the lack of supplies were done in the past. Other efforts to address VAD is food fortification. Stability studies on vitamin A fortified flour and production of fortified bread, research on sugar fortification with vitamin A, 1996 commercial pilot scale on oil with vitamin A. In 1997, 2 mills started to commercially produce vitamin A fortified flour and vitamin fortified sugar was launched by Victorian Milling Corporation, and in 1999 – Vitamin A fortified oil was made available in the market.
TU43

SERUM RETINOL CONCENTRATIONS FOR ASSESSING PROGRAMME IMPACT OF VITAMIN A INTERVENTIONS IN 3 POPULATIONS

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Background: Serum retinol concentrations measured by HPLC are accepted as the gold standard to assess the vitamin A status of a population and the impact of vitamin A intervention programmes. However, serum retinol is influenced by factors that affect the release of holo-retinol binding protein from the liver, e.g. protein-energy malnutrition and the acute phase response.

Aims: To investigate the impact of similar vitamin A interventions in children 6–59 months of age in Zambia, the Philippines and Nicaragua using serum retinol concentrations.

Results: Following supplementation (6–12 months, 12–18 months, 18–24 months, >24 months) there was no significant improvement in overall mean serum retinol concentrations or the prevalence of VAD in either Zambia (serum retinol 1.04 µmol/L (1996) and 0.72 µmol/L (2001); VAD 66% (1996) and 54% (2001)), or the Philippines (VAD 36% (1993), 38% (1996) and 40% (2003)). In Zambia between 1996 and 2001, there was an increased prevalence of child malnutrition due to a combination of drought and HIV/AIDS, which impacted on household food security and the health of children. Likewise, in the Philippines a serious economic crisis and a drought coincided with an increase in the prevalence of underweight, wasting and stunting among children increasing their susceptibility to infection and VAD. However, correcting the 2003 Zambian data for current inflammation revealed a positive impact of supplementation on blood levels. Likewise in the Philippines, mean plasma retinol concentrations of children with infection (based on maternal recall) were 0.79 µmol/L and of those without were 0.83 µmol/L. In contrast in Nicaragua, there was significant progress in social development between 1997 and 2003, the GDP increased and the prevalence of children with HAZ <−2 decreased, indicating a positive impact of nutrition and health interventions. Serum retinol concentrations were normal (1.31 µmol/L) and although lower in those with inflammation (1.18 µmol/L) they were still in the normal range.

Discussion: The lack of response of serum retinol to supplementation suggests apparently good capsule coverage (>75% at least once/year) was not a proxy for impact. Sub-clinical inflammation depressed plasma retinol concentrations in all 3 countries, but in Nicaragua the impact was minimal. In Zambia, correcting for the influence of inflammation revealed a positive impact on plasma retinol post-supplementation. The data illustrate the importance of considering environmental factors that influence inflammation in interpreting plasma retinol.

TU44

EFFECTS OF NATIONAL LOW DOSE VITAMIN A SUPPLEMENTATION PROGRAMME IN SRI LANKA

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Background: National survey indicated that the prevalence of Vitamin A deficiency in Sri Lanka was 35% in 1995. Vitamin A mega dose supplementation was initiated in year 2000 and Sri Lanka has adopted a different schedule of supplementation than the global recommendation. A dose of 100,000IU has been given to children under 5 years of age at the age of 6 months, 18 months and 3 years and 200,000IU for postpartum mothers within 4 weeks of delivery. The coverage of the Vitamin A supplementation programme was 75%. Hence this national survey was conducted to see the impact of the supplementation programme.

Objectives: To study the impact of Vitamin A supplementation programme in Sri Lanka.

Methods: Multistage cluster sampling technique was used to draw a nationally representative sample and 800 children aged 6–59 months were included. Blood samples were analysed from 768 children and serum retinol concentration was measured using HPLC method. Blood samples were collected from lactating mothers and 290 samples were obtained and analysed. Serum retinol concentration of <20 µg/dL as the cut-off point for severe VAD and <10 µg/dL as the cut-off point for moderate VAD was varied with the interval between the survey date and the last date given the Vitamin A intervention.

Results: Serum retinol concentration indicated severe deficiency has reduced from 9% to 2% and moderate deficiency has changed from 26.3% to 27%. Overall vitamin A deficiency (VAD) has reduced from 35% to 25% within the group-children aged 6–59 months. VAD has not been seen to be associated with gender. However, the effect of VAD was varied with the interval between the survey date and the last date given the Vitamin A mega dose supplementation. Mean serum retinol level of the children who received Vitamin A megadose within last 6 months, 6–12 months, 12–18 months, 18–24 months, >24 months and not at all received was 3.07, 2.27, 2.41, 2.44, 2.20, 2.24 and 2.26 µg/dL respectively. Only 13.6% of lactating mothers were Vitamin A deficient.

Conclusions: It indicates that 100,000IU dose is effective to increase the serum Vitamin A levels up to 6 months period. Interval between two doses was too long to reduce the Vitamin A deficiency among children. Therefore it is recommended to revisit the supplementation strategy according to the global recommendations.

TU45

COST IMPLICATION OF A LOW DOSE VITAMIN A SUPPLEMENTATION IN SRI LANKA

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Background: Sri Lanka started its vitamin A supplementation programme after a base-line assessment in 1995/6 documented very high level of vitamin A deficiency. Since then, children between 6–59 months were getting three doses of vitamin A supplementation of 100,000 IU, which is far below the standard WHO/UNICEF global recommendation. Recent evaluation and estimates raise the question whether the supplementation has been effective and is it worth of the investment made.

Objective: To investigate the impact of Vitamin A supplementation is a cost-effective intervention for Sri Lanka and if further investment is suggested

Methods: Secondary analysis of information revealed from different studies and estimates done recently. Effectiveness of the vitamin A supplementation was assessed by comparing the results from Vitamin A status of 6–72 months old children in 1995/1996 and then 2006/7. Cost estimates of vitamin A supplementation was taken from a recent World Bank study on cost-benefit of Nutrition Programmes in Sri Lanka.

Result: A World Bank study on Malnutrition situation in Sri Lanka suggests that Vitamin A supplementation in Sri Lanka is not as cost-effective as in other countries since the mortality is too low. It quotes a per capita investment of US$ 1.08 for high dose vitamin A supplementation that amounts to about US$ 760,838 annual cost for 80% coverage. However, the authors would like to argue that more than the issue of disease burden or low mortality, it is the issue of effectiveness of the low-dose intervention that is making the vitamin A supplementation less cost-effective intervention for Sri Lanka. This is evident from the recent study on assessment of vitamin A status (2006–7) that shows no significant decrease in vitamin A deficiency documented through a baseline study in 1995–6 despite the fact that there has been a vitamin A supplementation during these years in between.

Conclusions: Sri Lanka has been investing about US$ 8 million dollar in last 10 years for Vitamin A supplementation (two thirds of which comes from development partners) but there is question that benefit of this investment has not been fully realized due to sub-optimal dosing of vitamin A supplementation. Hence, a drastic shift in dose schedule is strongly recommended and it should be as per the global recommendation with operations research with operations research and impact evaluation to look at the outcome at an interval of 2 & 5 years respectively.

TU46

MATERIAL POST-PARTUM VITAMIN A SUPPLEMENTATION FOR THE PREVENTION OF MORTALITY AND MORBIDITY IN INFANCY: SYSTEMATIC REVIEW OF RANDOMIZED CONTROLLED TRIALS

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Objective: To evaluate the effect of maternal post-partum vitamin A supplementation (VAS) on infant mortality, morbidity and early adverse effects.

Design: Systematic review, meta-analysis and meta-regression of randomized controlled trials.

Data sources: Electronic databases and abstracts and proceedings of micronutrient conferences.

Review Methods: Randomized or quasi-randomized, placebo controlled trials evaluating the effect of prophylactic, maternal synthetic VAS on mortality or morbidity within infancy (<1 year), or early adverse effects (<6 days).

Results: The 7 included trials were from developing countries. There was no convincing evidence of a reduced risk of mortality during infancy (RR 1.05, 95% CI 0.92 to 1.21, P=0.439, I²=0%, P=0.937). No variable emerged as a significant predictor of mortality but data for important risk groups (high maternal night blindness prevalence and low birth weights) was restricted. Neonatal mortality data was available from a single study, RR 1.09 (95% CI 0.88, 1.35, P=0.423). Amongst the 2 trials providing data on cause-specific mortality, there was no evidence of a reduced risk of deaths due to respiratory causes, diarrhoeal etiologies, or causes other than respiratory or diarrhoeal morbidities. In the only study with morbidity data, there was no evidence of a decrease in either diarrhea or acute respiratory infection. Information on severity of morbidities was not available in any trial. No adverse effects were reported in the single relevant study.

Conclusions: Following maternal post-partum VAS, there is no convincing evidence of a reduced risk of mortality and possibly morbidity or of increased early adverse effects.
ABSTRACTS

Tuesday, 12 May, 2009

Vitamin A Deficiency and Vitamin A Supplementation Interventions

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12-15 MAY 2009 ❘ BEIJING, CHINA
TU51

AN INVESTIGATION OF MATERNAL HEPATIC AND BREASTMILK VITAMIN A TRENDS POSTPARTUM

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Background: Vitamin A deficiency (VAD) is associated with elevated morbidity and mortality. Neonates have measurably lower VA stores, and are dependent on breastmilk for nutritional needs and for building liver stores needed after weaning. VAD mothers produce breastmilk with low VA, compromising their children’s VA status. It has been documented that VA concentrations in breastmilk decline across the first year postpartum in women from both developed and developing nations, but the reason for the decline has not been investigated and assumed to be a sign of depleting maternal hepatic stores. Why the decline is pervasive despite adversity on child health merits investigation.

Aims: We develop explanatory models to investigate this gap between breastmilk VA and maternal hepatic VA based on empirically tested theoretical models using data from northern Kenya.

Methods: We use cross-sectional data from 241 lactating Ariaal mothers of Marsabit District, Kenya. Paired breastmilk and blood samples were collected from each mother for determining milk retinol concentrations and hepatic retinol stores via the relative-dose response test based on serum retinol. Paired trends in milk and liver retinol were examined using linear regression models.

Results: Results indicate that maternal liver retinol is in a trade-off relationship with milk retinol postpartum. Breastmilk retinol does not track maternal hepatic retinol, but instead declines despite increasing liver stores in the late postpartum period.

Conclusions: Our observation negates the long held assumption that breastmilk VA concentrations are in direct relationship with maternal hepatic stores. This calls for further investigation into the partitioning of VA between breastmilk and maternal liver postpartum. This has an important implication for the efficacy of the currently recommended public health strategy of high-dose postpartum maternal VA supplementation. The policy implication will be explored.

Supported by NSF Dissertation Improvement Grant #0622358 to BSD/IM, Wenner-Gren Foundation Research Grant #7460 to MF, and Micronutrient Initiative Grant to BSD/MF.

TU52

ARE HOUSEHOLD MONITORING SURVEYS GOOD TOOLS FOR MEASURING VITAMIN A SUPPLEMENTATION COVERAGE?

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Background: Vitamin A capsule coverage is most often derived from tallies of children supplemented during campaigns. Estimates are subject to error due to inaccurate counts of numbers of targeted children. Household surveys are generally considered a more reliable data source. However, there is no gold standard measure of vitamin A capsule receipt. Immunization campaigns, (e.g., National Immunization Days or NIDs) have been ongoing for decades in most countries with vitamin A supplementation programs and social mobilization around these events is intensive. Thus, it has been assumed that maternal recall of child participation and vitamin A receipt is reliable and accurate.

Aim: To estimate the validity of vitamin A capsule receipt reported in household surveys.

Methods: Internal UNICEF/WHO records were used to determine which immunization campaigns also included vitamin A supplementation. Questions on immunization campaign participation and vitamin A capsule receipt are included in separate sections of the standardized Multiple Indicator Cluster Survey (MICS) and Demographic and Health Survey (DHS) questionnaires. Co-positivity was defined as the proportion of children who participated in the immunization campaign and who also reported receiving vitamin A. Co-negativity was defined as the proportion of children who did not participate in the immunization campaign and who also reported not receiving vitamin A. Percent agreement and chance-correct agreement were also calculated.

Results: Data from 22 campaigns in 19 countries were included. In all but two instances, immunization campaign coverage exceeded that of supplementation. Immunization coverage was 20.3% higher, on average, than capsule coverage. Co-positivity ranged from 20.1% to 88.4% and co-negativity ranged from 45% to 89.6%. Percent agreement was generally high (66.5% on average), but after adjusting for chance agreement, κ scores ranged from 20.1% to 88.4% and co-negativity ranged from 45% to 89.6%. Percent agreement was generally high (66.5% on average), but after adjusting for chance agreement, κ scores ranged from 20.1% to 88.4% and co-negativity ranged from 45% to 89.6%.

Conclusions: Household monitoring surveys may not provide accurate estimates of vitamin A capsule coverage when supplements are delivered via campaigns. Further work is needed to understand the reasons behind these discrepancies and to revise methodologies such that household monitoring surveys provide a more accurate picture of supplementation coverage.

TU53

ASSESSMENT OF PREGNANCY-RELATED NIGHT BLINDNESS IN STANDARDIZED HOUSEHOLD MONITORING SURVEYS

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Background: History of maternal night blindness is an accepted population-based indicator of vitamin A deficiency (VAD). A prevalence ≥5% is suggestive of a significant public health problem. Guidelines for assessment recommend the use of local formulas for the condition and a recall of all pregnancies resulting in a live birth within the prior three years. Where a local term for the condition is not available, a description of the symptoms may be used. Existing daytime vision problems during pregnancy over the same period has also been recommended as a way to exclude other forms of visual impairment. Standardized questions based on these guidelines have since been integrated into both the UNICEF-supported Multiple Indicator Cluster Surveys (MICS) and ORC Macro’s Demographic and Health Surveys (DHS).

Aim: To estimate the prevalence of maternal night blindness as reported in household monitoring surveys.

Methods: We compiled prevalence estimates of night blindness, both adjusted and unadjusted for daytime vision problems, from UNICEF-supported MICS or DHS. Each was carried out in 32 countries classified as at risk of VAD by the World Health Organization. Findings: Percentages of women reporting vision problems at night ranged from 2.7% to 26.4%, with an unweighted mean prevalence of 11.7%. Adjustment for daytime vision yielded prevalence estimates ranging from 0% to 7.9%, or an unweighted mean of 2.7%, indicating that 3/4ths of women reporting difficulties seeing at dusk or at night time also reported other daytime vision problems. Adjusted night blindness prevalence estimates suggest a VAD problem of public health importance in only five of the 32 countries previously characterized as high risk.

Conclusions: A rising concern is that Methods that disregard histories of night blindness when they are co-reported with any daytime vision problems is likely to underestimate true prevalence of night blindness and VAD. Where local terms for the condition are not available, full adjustment for daytime vision problems: 1) assumes that night blindness and daytime vision problems are mutually exclusive, and 2) gives absolute weight to daytime vision problems of uncertain nature, and regardless of severity. There is a need for ophthalmologic studies to determine the degrees to which night blindness and other vision problems, especially refractive error, vary in populations. For the time being, we suggest that both unadjusted and adjusted estimates of night blindness be reported with notation to indicate that true prevalence lies within this range.

Supported by the Ofc of Health, Inf Diseases and Nutrition, USAID, Wash DC, the Bill & Melinda Gates Foundation, Seattle, WA, with added support from the USAID Mission, Dhaka, The Sight and Life Research Institute, Baltimore, MD, ACCESS Business Group, Buma Park, CA and CDB’s Micronutrient Initiative, Ottawa, Canada.

TU54

POOLED ANALYSIS OF ASIAN NEWBORN VITAMIN A SUPPLEMENTATION TRIALS TO ASSESS DIFFERENTIAL EFFECTS ON EARLY INFANT MORTALITY

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Background: Newborn vitamin A supplementation has been tested in three field trials in Southern Asia (Indonesia, India and Bangladesh), each of which has reported significant reductions of ~15% in infant mortality in the 1st six months of life.

Aims: We explored whether relevant factors—including age at newborn dosing, gestational age, gender, parity, birth size, time at breast feeding initiation, and measures of socioeconomic status (SES)—moderated the effect of newborn vitamin A on reducing mortality through 6 months of age.

Methods: We conducted a pooled-analysis of data on all-cause mortality from the three Southern Asian trials where infants were enrolled and supplemented with ~50,000 IU vitamin A near birth and followed through six months of age. We explored whether relevant factors—including age at newborn dosing, gestational age, gender, parity, birth size, time at breast feeding initiation, and measures of socioeconomic status (SES)—moderated the effect of newborn vitamin A on reducing mortality through 6 months of age.

Results: A pooled-analysis of these three studies suggests that newborn vitamin A dosing can decrease mortality through 6 months of age by ~1% and that vitamin A receipt was associated with protective relative risks (RR) for boys (RR = 0.80) and girls (RR = 0.83), infants of low (<2500 g) RR = 0.82) and normal (RR = 0.84) birth weight, for term (~37 weeks) gestation, RR = 0.76) more than preterm (RR = 0.90) infants, for infants born to primiparous (0.87) and multiparous (0.77) women, and for infants born to mothers >30 years of age (RR=0.68) more than mothers aged 21-29 (RR=0.82) and ≤20 years (RR=0.90).

Conclusions: The size and consistency of effect sizes across subgroups provides evidence of variability in impact, due to chance or other reasons, as well as an assurance that a positive effect on survival may be expected by dosing newborns with vitamin A across diverse population groups of Southern Asia. The findings suggest a need for regional dialogue to develop policies and explore program approaches to deliver vitamin A at birth.

Supported by the Ofc of Health, Inf Diseases and Nutrition, USAID, Wash DC, the Bill & Melinda Gates Foundation, Seattle, WA, with added support from the USAID Mission, Dhaka, The Sight and Life Research Institute, Baltimore, MD, ACCESS Business Group, Buma Park, CA and CDB’s Micronutrient Initiative, Ottawa, Canada.
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TU56

VITAMIN A DEFICIENCY AND SUB-CLINICAL INFECTIONS IN PRESCHOOL CHILDREN OF NORTH WEST FRONTIER PROVINCE, PAKISTAN

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Background: Data on prevalence of vitamin A deficiency and sub-clinical infection presented herein is a part of nutrition survey conducted on 6-60 month old children in North West Frontier Province (NWFP), Pakistan.

Aims: The purpose of the study was to assess the vitamin A deficiency among preschool children along with sub-clinical infections by using different markers of infections.

Methods: A two-stage cluster sampling technique was used to select 3074 children from 40 clusters of NWFP. Five ml blood sample was collected from each child for the determination of plasma retinol and acute phase proteins, α1-acid glycophorin (AGP) and α1-antichymotrypsin (ACT) by High Performance Liquid Chromatography and Immunoturbidimetric Methods, respectively. The prevalence of sub-clinical vitamin A deficiency and sub-clinical infections was assessed by using recommended cut-off values.

Results: The results revealed that the children had mean plasma retinol of 0.90 ± 0.38 µmol/l (25.80 ± 11.02 µg/dl) and there was no significant difference in the mean plasma retinol between boys and girls. The prevalence of moderate vitamin A deficiency (retinol <0.7 µmol/l) among children was 31.8% while severe vitamin A deficiency (retinol <0.35 µmol/l) among children was 3.3%. The prevalence of chronic infection (only raised AGP), acute infection (only raised ACT) and chronic-acute infection (both raised AGP and raised ACT) in the moderate vitamin A deficient children were 36.6%, 0.8% and 15.3%, respectively.

Conclusion: The study suggests that vitamin A deficiency and sub-clinical infection among preschool children were prevalent to the extent of being considered a public health problem which demands interventions to reduce and control both sub-clinical vitamin A deficiency and infections.
TU57  RELATIONSHIP BETWEEN ANEMIA AND BIOMARKERS OF INFAMMATION IN CHILDREN

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Background: Anemia presents a serious global public health burden, especially in developing countries where poor nutritional status and infection are common. Some measures of micronutrient status are affected by the acute phase response to inflammation. This investigation assesses the association of acute-phase proteins with the prevalence of anemia. Aim: To assess the association between anemia status and the acute-phase protein biomarkers C-reactive protein (CRP) and α1-acid glycoprotein (AGP) in children 6-59.9 months of age in Papua New Guinea.

Methods: The 2005 Papua New Guinea National Micronutrient Survey was a stratified, probability proportional to size (PPS) cluster survey. Data on 878 children 6-59.9 months of age were used in the analyses which account for the complex sample design. Logistic regression models were used to assess the relationship between anemia status and elevated CRP status and between anemia status and elevated AGP status. Anemia was defined as a haemoglobin <11 g/dl adjusted for altitude, elevated CRP as >5 mg/L, and elevated AGP as >1.2 g/L. Interaction and confounding by other factors, such as age, low haemoglobin, and vitamin A capsule use, were assessed.

Results: The overall prevalence of anemia was 48%. The prevalence of elevated CRP and elevated AGP was 32% and 33%, respectively. Both CRP and AGP were significantly associated with anemia. For elevated CRP, AGP anemia prevalences were 66% vs. 40%, respectively; for AGP, 61% vs. 42% respectively. These results were still present after accounting for confounding. While the estimated prevalence of anemia was 48%, with an assumed hypothetical range of elevated CRP or AGP between 25% and 40%, the estimated prevalence of anemia would range between 40% and 50%.

Conclusions: This study finds that elevated CRP and AGP were significantly associated with the prevalence of anemia in the children surveyed and accounting for confounders. However, estimations of different prevalences of elevated AGP show minimal effect on anemia prevalence and suggest no need to adjust anemia prevalence for elevated CRP or AGP in this population. The relationship of four categories of combined CRP and AGP status (no inflammation, incubation, early convalescence, and late convalescence) to anemia will also be presented as well as elevation to either CRP or AGP.

TU58  DO ELEVATED LEVELS OF ALPHA-1 ACID GLYCOPROTEIN (AGP) AFFECT THE PREVALENCE OF ANEMIA IN PRESCHOOL CHILDREN?

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Background: Inflammation has been shown to affect the prevalence of biomarkers of micronutrient status, such as ferritin and retinol. The relationship with anemia prevalence has been less studied.

Aim: To determine if elevated AGP levels, an acute-phase inflammatory response protein, affect the prevalence of anemia in children aged 6-59 months and consider implications for anemia prevalence analysis.

Methods: The Nicaraguan SNMVS surveillance system collects data from a nationally representative sample of the population annually. Survey sampling is based on a complex, stratified, multistage probability cluster design and includes households with children 6-59 months of age. From 2003-2005, 1500 households were sampled. Caregivers in each household were interviewed to obtain information on the dwelling, family, mother, and children 6-59 months of age. Data on 878 children 6-59.9 months of age used in the analyses which account for the complex sample design. Logistic regression models were used to assess the relationship between anemia status and elevated AGP status and between anemia status and elevated CRP status. Anemia was defined as a haemoglobin <11 g/dl adjusted for altitude, elevated CRP as >5 mg/L, and elevated AGP as >1.2 g/L. Interaction and confounding by other factors, such as age, low haemoglobin, and vitamin A capsule use, were assessed.

Results: The overall prevalence of anemia was 48%. The prevalence of elevated CRP and elevated AGP was 32% and 33%, respectively. Both CRP and AGP were significantly associated with anemia. For elevated CRP, AGP anemia prevalences were 66% vs. 40%, respectively; for AGP, 61% vs. 42% respectively. These results were still present after accounting for confounding. While the estimated prevalence of anemia was 48%, with an assumed hypothetical range of elevated CRP or AGP between 25% and 40%, the estimated prevalence of anemia would range between 40% and 50%.

Conclusions: This study finds that elevated CRP and AGP were significantly associated with the prevalence of anemia in the children surveyed and accounting for confounders. However, estimations of different prevalences of elevated AGP show minimal effect on anemia prevalence and suggest no need to adjust anemia prevalence for elevated CRP or AGP in this population. The relationship of four categories of combined CRP and AGP status (no inflammation, incubation, early convalescence, and late convalescence) to anemia will also be presented as well as elevation to either CRP or AGP.

TU59  SYSTEMATIC REVIEW AND EVALUATION ON CHINESE DIETARY VITAMIN INTAKE AND DEFICIENCY IN RECENT YEARS

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Objective: To investigate the regional and subpopulation’s vitamin intake and the bibliometric characteristics and research trends for getting a comprehensive and professional report on Chinese vitamin intake and deficiency for the reference of public nutrition improvement.

Methods: To apply literature systematic review of evidence-based medicine, bibliometric methodology and nutrition evaluation in implementing a systematic, comprehensive and professional analysis and evaluation on the literature and findings of Chinese dietary vitamin intake in 2000–2008.

Results: 141 research papers on Chinese dietary vitamin intake status and 90% focused on VA, VB1, VB2 and VC. By China regionalization, most papers came from China East Area, or the East economy-developed zone or the Southern geographical region. The average VA intake of overall populations was about 24 mg Chinese Dietary Reference Intakes (DRIs). Except for preschool children (11.7±2.6mg/D) and soldier group (12.7±2.6mg/D), no other sub-population got enough VA intake, especially for group (53.1±13DRIs). VB7 severe deficiency took place in infant, athlete and elder populations (40%, 43.3% and 67.9% DRIs respectively). VB12 intake only reached 60–80% DRIs in most populations besides pregnant women. Most populations had VB1 deficiency especially infant, school-aged children, preschool children and elder (42.90%, 29.39%, 61.01% and 69.46% DRIs respectively). Most populations got enough niacin and VB12 intake except for infant and pregnant women. Studies on the dietary intakes of VB6, VB12 and other vitamins were quite few. Dietary vitamin intakes in China East and northeast were better than other regions, and were very poor in North-China. VA intake reached the highest in last economy-developed region. VB1 and VB12 intakes were not much different between East economy-developed region and West economy-underdeveloped region, but reached the highest values in central economy-sub-developed part. Reasons for VA, VB12 did not show apparent difference among three economic zones. Qinghao and Tibet region was poor in all vitamin intakes. Conclusions and Suggestions: No sub-population met the DRIs standards of every vitamin intake with more severe deficiencies in infant and elder populations. VA, VB1, VB12 and VC were the most deficient vitamins in Chinese residents. There were region and population differences in vitamins dietary intake, and hence region population& sub-population solutions should be made in improving Chinese vitamin nutrition status. Quality control should be emphasized in future. Much valuable data and results achieved here were just one step towards scientific and statistical summary of current researches, and might not represent the real intake values of Chinese residents while considering the impacts from sampling number, district environment, living condition etc.

Keywords: Chinese resident, Vitamin Intake, Micronutrient deficiency, Systematic review, Bibliometrics
TU61  SERUM TRANSFERRIN RECEPTOR CONCENTRATIONS AND TOTAL BODY IRON IN US PRESCHOOL CHILDREN, NON-PREGNANT WOMEN OF CHILDBEARING AGE, AND PREGNANT WOMEN, NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY, 2003-2006

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Abstracts

Background: Serum soluble transferrin receptor (sTfR) is affected by increased cellular iron demands and erythropoiesis and is recommended as a sensitive and accurate measure of iron deficiency in populations. Total body iron calculated from serum ferritin and sTfR allows evaluation of the full range of iron status. We describe the distributions of sTfR and total body iron for 1,569 US children aged 1-5 years, 3,271 non-pregnant women aged 12-49 years, and 579 pregnant women included in the National Health and Nutrition Examination Survey in 2003-2006. sTfR and serum ferritin concentrations were measured using immunoturbidimetry (Buche Diagnostics, Marenheim, Germany). Body iron was calculated using a formula from Cook et al (Blood 2004;101:13159). Sample weights and SUDAAN were used for all the estimates to account for the complex sample design.

The data revealed:

<table>
<thead>
<tr>
<th>Geometric mean±SE</th>
<th>Median</th>
<th>25th percentile</th>
<th>75th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>sTfR (mg/L)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td>4.41±0.03</td>
<td>4.21</td>
<td>3.67</td>
</tr>
<tr>
<td>Non-pregnant women</td>
<td>3.65±0.04</td>
<td>3.31</td>
<td>2.79</td>
</tr>
<tr>
<td>Pregnant women</td>
<td>3.59±0.09</td>
<td>3.17</td>
<td>2.70</td>
</tr>
</tbody>
</table>

Total body iron (mg/kg)

<table>
<thead>
<tr>
<th>Geometric mean±SE</th>
<th>Median</th>
<th>25th percentile</th>
<th>75th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>3.47±0.08</td>
<td>3.64</td>
<td>2.21</td>
</tr>
<tr>
<td>Non-pregnant women</td>
<td>5.49±0.08</td>
<td>5.63</td>
<td>3.89</td>
</tr>
<tr>
<td>Pregnant women</td>
<td>4.24±0.10</td>
<td>4.23</td>
<td>1.75</td>
</tr>
</tbody>
</table>

On average, US children aged 1-5y have higher sTfR concentrations and lower total body iron when compared with non-pregnant childbearing aged women and pregnant women (p<0.02 for all pairwise comparisons). Although sTfR concentrations did not differ by pregnancy status (p=0.366), pregnant women had lower total body iron than non-pregnant women (p=0.0004). Among children, 6.7% had body iron stores <0 mg/kg, compared with 2.9% of non-pregnant women aged 12-49y, and 16.1% of pregnant women. Excluding individuals with anemia or elevated C-reactive protein did not affect results substantially. These are the first data on sTfR concentrations and body iron distributions on a representative sample of the US population.

 TU62  COMPARISON OF A COMMERCIAL HPLC-UV KIT ASSAY FOR 25-HYDROXY-VITAMIN D’WITH A HPLC-MS/MS REFERENCE METHOD

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Aims: The purpose of this study was to test a commercial HPLC-UV kit (ICN Diagnostics, Golden, Colorado) for ease of use, and compare it with the LC-MS/MS reference method for precision and agreement.

Methods: A novice analyst with minimal laboratory experience was tasked to set-up the assay under the guidance of an experienced chemist. He performed 9 assays using three kits. Two QC pools were included in duplicate in each assay. Sample preparation involved simple protein precipitation for LC-MS/MS and protein precipitation followed by solid-phase extraction for the HPLC-UV method. Both Methods incorporated internal standards to account for procedural losses.

Results: Inter-assay coefficients of variation were 17% and 16% for 25(OH)D3 and 25(OH)D2, respectively. In a method comparison using 85 convenience samples, too few specimens had 25(OH)D3 to estimate bias; 25(OH)D3 concentrations ranged from 6.6-57.4 ng/mL (LC-MS/MS). The distribution of the 25(OH)D values in both assays was nearly normal. Assay bias was essentially nil. Bland-Altman estimated no significant difference (-0.157 ng/mL; 95% CI: -1.14 to 0.82).

Conclusions: The strengths of the HPLC-UV kit are that it is suitable for a lab with conventional HPLC equipment, is relatively easy to use, and showed no bias against a reference method in a small set of samples. The precision of the method was acceptable and might improve further with experience. The weaknesses are that it is probably too expensive for most laboratories in developing countries and, as with all kit Methods it’s difficult for the laboratory to troubleshoot assay problems because the reagents and supplies are proprietary.

TU63  ASSESSMENT OF VITAMIN A DEFICIENCY IN WOMEN AND CHILDREN FROM PAPUA NEW GUINEA USING DRIED BLOOD SPOT RETINOL-BINDING PROTEIN

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Aims: To determine 1) if DBS RBP can be used as a surrogate for serum retinol concentration; and 2) an appropriate RBP cut-off for vitamin A deficiency (VAD).

Methods: Serum retinol was measured using HPLC-UV, CRP and CRP were measured using ELISA. RBP concentrations were compared with serum retinol for correlation; the sensitivity and specificity of different RBP cut-offs were investigated using receiver-operator characteristic (ROC) curves. VAD was defined as serum retinol <0.70 µmol/L. Data were analyzed using Analyse-it software.

Results: In this small sub-study, no children were malnourished, 6% of the women were overweight, and prevalence of infection was moderate to low (children 11%, women 3%). There was a strong correlation between serum retinol and RBP in DBS (r=0.83). The correlation between retinol and RBP in DBS was similar (r=0.85) when serum retinol was corrected using hematocrit. ROC analysis showed that an RBP cut-off <0.71 µmol/L gave strong agreement with serum retinol for predicting VAD with an area under the curve of 0.99 (95% CI: 0.96-1.00) and high sensitivity (98%) and specificity (94%). An RBP cut-off <0.70 µmol/L classified 11.6% with serum retinol for predicting VAD with an area under the curve of 0.99 (95% CI: 0.96-1.00) and high sensitivity (89%) and specificity (97%). An RBP cut-off <0.73 µmol/L classified 11.6% with serum retinol for predicting VAD with an area under the curve of 0.99 (95% CI: 0.96-1.00).

Conclusions: Dried blood spot RBP appears to be an excellent surrogate for serum retinol. An appropriate RBP cut-off appears to be close to the recognized serum retinol cut-off for vitamin A deficiency.
TU64

NUTRITIONAL ASSESSMENT OF SETTLED AND SEMI-SETTLED
GABRA WOMEN AGED 15-49 YEARS IN MARSABIT DISTRICT, KENYA, IN RELATION TO RECOMMENDED DIETARY ALLOWANCE

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Frequent droughts experienced by pastoralists in the recent times have had a devastating effect on livestock population leading to increased sedentarization in urban centres. While sedentarization provides amenities such as health facilities, education among others, problems such as malnutrition among women have been observed in Marsabit District. The objective of this study was to evaluate food consumption and nutritional status among non-pregnant Gabra women aged 15-49 years. The research was cross-sectional survey design using semi-structured questionnaire. Two hundred and twenty four (224) women aged 15-49 years were randomly interviewed in Kalacha Location. Food Frequency Questionnaire (FFQ) and 24 Hour Diet Recall (24HDR) were administered to assess dietary intake levels among women. Anthropometric parameters, height, BMI and WHR were measured. Data was analyzed using Epi Info Version 3.4.3 software. The results show that there is undernourishment of women. The mean BMI of women in settled area was 20.3 ± 4.9 while the mean BMI of semi-settled women was 18.7 ± 3.8. There was no statistically significant difference between females in both areas. In addition, semi-settled women had a slightly higher mean BMI (19.3 ± 3.2) when compared to semi-settled women (18.7 ± 3.8) but, the difference was not statistically significant. Women in settled areas had significantly higher energy intakes (P < 0.001, 95% CI) than semi-settled women, but, intakes were below the Recommended Nutrient Intake (RNI) levels. Excess for Zinc, Magnesium, total Fats and sugar, most nutrients were below the RNI in both settlements. Sixty percent of semi-settled women and thirty nine percent of settled women were anaemic (Hb < 12 mg/dL). In conclusion, settled women had a relatively better nutritional status than their semi-settled counterparts. Inadequate intakes were largely due to food inaccessibility mainly caused by economic constraints and non availability of foods within the locality. Fortification should be looked into as a policy strategy in addressing high micronutrient deficiencies in this region.

Keywords: Settled and semisettled women; Nutritional assessment, Recommended Nutrient Intake

TU65

AN ADVANCED, PORTABLE DARK ADAPTOROMETER FOR ASSESSING FUNCTIONAL VITAMIN A DEFICIENCY – A MICRONUTRIENT FORUM UPDATE

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The dark adaptometer is currently undergoing field testing and validation against human subjective measures of visual function in Kagel Chota, India. Stimuli are applied at 10s intervals with increasing intensity until a pupillary contraction is observed. In this study the device was given to a subject, to fit over their eyes, and a pair of on-off switches on the side of the device were used to select stimulus levels, and provide feedback for stimulus adjustments. The device is expected to meet the requirements of field testing and validation. The Field Test will involve 298 individuals, with 100 controls and 198 cases of clinical vitamin A deficiency. A second Field Test will be conducted in Nigeria. This approach is expected to greatly expand the number of people who can be evaluated for vitamin A deficiency

Keywords: Dark adaptometer, African children, Functional vitamin A deficiency

TU66

VALIDATION OF DIETARY DIVERSITY SCORE AS INDICATOR OF NUTRIENT ADEQUACY

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Background: The diversity of a diet offers a potentially simple measurement of diet quality and adequacy of nutrient intake, with prospective application in large community surveys to assess micronutrient intake and the promotion of diet diversity.

Aims: To validate dietary diversity score as an indicator of nutrient adequacy of the diet of non-pregnant Filipino children 2-5 years old. Specifically, it aimed (1) to classify individual foods into a standardized set of 10 food groups, and calculate a Dietary Diversity Score (DDS) for each child; (2) to estimate the Probability of Adequacy (PA) of intake of these nutrients based on Estimated Average Requirements (EAR) and Recommended Nutrient Intake (for iron); (4) to assess the strength of the relationship between DDS and PA.

Methods: Data from the 2001 National Nutrition Survey (NNS) Food Consumption Survey (FCS) component were utilized, covering 2,755 children from statistically selected households. DDS was defined as the number of food groups consumed by each child from among 10 food groups: (1) cereals, roots and tubers; (2) vitamin A-rich fruits and vegetables; (3) other vegetables; (5) legumes, pulses and nuts; (6) oils and fats; (7) meat, poultry, fish; (8) dairy; (9) eggs; (10) “other” (sweets, snacks, condiments, etc). PA was estimated based on “no minimum” and “10 gram minimum” intake. In addition to nutrient intakes computed using Philippine Food Composition Table (FCT), vitamin B6, vitamin B12, folate, zinc and phytate intakes were assessed using the WorldFood Dietary Assessment System, v.2. The PA for each nutrient intake was determined based on the EAR and percent RNI for iron. Sensitivity and specificity of DDS were evaluated based on mean PA > 50% and 60%

Results: Mean DDS was 4.9 and 4.4 when no minimum and 10 gram minimum intake were applied, respectively. The mean PA (MPA) was 43%. Only two nutrients, nacin and vitamin B6, had PA above 50%. Pearson’s correlation between DDS and nutrient PAs and MPA were highly significant. The Pearson EAR and PA of nutrients increased, as DDS increased. A DDS between 4 and 5 maximized sensitivity and specificity both at MPA > 50% and 60%

Conclusions: The DDS may be a useful indicator to measure diet adequacy in nutrition surveys that may be constrained by resource availability. The next steps are to examine association between DDS and nutritional status, and validate its usefulness for other population groups (e.g., pregnant women).

Keywords: Dietary diversity, Functional vitamin A deficiency, Nutrient adequacy

TU67

THE EFFECTS OF INITIATION AND DISCONTINUATION OF SHORT TERM ZINC SUPPLEMENTATION ON THE MAGNITUDE AND VELOCITY OF CHANGE IN PLASMA ZINC CONCENTRATIONS

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Background: to assist with the evaluation of zinc intervention programs, information is needed on the magnitude and velocity of response of serum (or plasma) zinc concentration following changes in zinc intake.

Aims: To measure the effects of initiation and discontinuation of each of two doses of short-term zinc supplementation on plasma zinc concentration (pl Zn conc). Methods: A randomized, double-blind placebo-controlled trial was conducted in 58 apparently healthy males 19-54y of age in Davis, CA.. Participants received one of three liquid supplements daily for 21 days: 10 or 20 mg zinc (Zn), as zinc sulphate, or placebo. Fasting blood samples were collected and processed according to IDCN guidelines. Biochemical indicators were measured at baseline (days -7 and 0), during supplementation (days 1,3,5,9,14 and 21) and post-supplementation (days 22,23,26,30,35 and 42). Information was collected on morbidity, medication intake, and fasting status. Data were analyzed using repeated measures ANCOVA. Results: The overall mean Zn pl conc at baseline was 78.1 ± 10.0µg/mL. Within-subject values one week apart at baseline were highly correlated (r=0.76; p<0.001), the subject-specific mean value was used to compare subsequent responses. Samples with elevated CRP (>10mg/L) had significantly lower pl Zn concs (p=0.006), and were eliminated from further analyses. The pl Zn conc increased by 0.008µg/mL for each additional hour since the last meal. Pl Zn conc was significantly related to day of study (p<0.001) and study group (p<0.001). The baseline pl Zn concs were not associated with the subjects’ age or BMI, and there were no differences in mean values by treatment group. Controlling for baseline levels, pl Zn concs were consistently elevated above baseline by day 5 among individuals in both of the zinc-supplemented groups compared with those individuals receiving placebo supplements, regardless of their initial pl Zn conc. Among individuals who received additional zinc, there were no significant group-wise differences in relation to the level of supplementation. Pl Zn concs of supplemented individuals declined following withdrawal of supplementation, and were no longer different from those of the placebo group by three weeks following discontinuation.

Conclusions: Plasma zinc concentration of healthy adults increases significantly within a few days of initiating supplementation with 10 or 20 mg zinc and returns to baseline levels within the remainder of the study. These time-course plots of discontinuation suggest zinc plasma concentration is a useful indicator of successful delivery of zinc supplementation.

Keywords: Zinc, plasma zinc, placebo, supplement, CRP, PA

ABSTRACTS

Tuesday, 12 May, 2009

MICRONUTRIENTS, HEALTH AND DEVELOPMENT: EVIDENCE-BASED PROGRAMS

12-15 May 2009  BEIJING, CHINA

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TU68 THE 13C-RETINOL ISOTOPE DILUTION TEST HAS 100% SENSITIVITY TO PREDICT HYPERVITAMINOSIS A IN CAPTIVE RHESUS MONKEYS

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Background: The 13C-retinol isotope dilution test (13C-RID) has significant public health potential for the classification of vitamin A status in non-human primates and has been shown to predict hypervitaminosis A (HVA) accurately using deuterated retinol. However, we have encountered difficulties with the recoveries of retinoid isotope tracers in dried blood spots (DBS) due to insufficient drying.

Methods: young rhesus macaques were administered the 13C2-retinyl acetate and blood was drawn 7 days later. Due to the very low isotopic enrichment of the tracer compared to the test sample, RBP isotope fractionation was not significant. The results were compared with the deuterated retinol dilution test (DRT) using 13C1-retinol.

Results: All monkeys had normal serum retinol levels at the start of the test before dosing but three developed HVA, with one monkey showing severe signs of vitamin A toxicity. Both the 13C-RID and DRT results were 100% concordant. The RBP isotope fractionation was below 1% for all animals.

Conclusions: We have shown that the 13C-RID can be used to accurately classify vitamin A status in non-human primates. This test promises to bring this much needed tool to the market.

TU69 CAN THE DRIED BLOOD SPOT TECHNIQUE BE IMPROVED BY AN EFFICIENT DRYING PROCEDURE AND CORRECTING THE RESULTS WITH THE HEMACOTRIC OF THE BLOOD SAMPLES?

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Background: Dried blood spots (DBS) are a convenient form for collecting blood samples especially in remote areas and it has been shown that they are suitable for measuring retinol binding protein (RBP), soluble transferrin receptor (STfR), C-reactive protein (CRP) and alpha-1-antichymotrypsin (A1AT) using an ELISA. However, some of the methods require a laboratory setting with strict quality control to maintain accuracy.

Aim: Recoveries of proteins in DBS from the field were identical as under laboratory conditions. We tested a new procedure to improve the results with higher values in samples with a low hematocrit.

Methods: From 38 women in a coastal area of Central Java, Indonesia, DBS were prepared under high humidity (80-90%) and temperature (> 30°C). For drying the dessicant was put directly underneath the DBS in nylon stockings spread over the bottom of an air tight plastic box to keep the humidity at < 20%. Additionally serum samples were collected and the hematocrit measured. The results were compared with the hematocrit values from the DBS.

Results: Our simple drying procedure gave under humid field conditions the same good recovery as DBS which were prepared under laboratory conditions. To avoid problems with DBS we strongly recommend using this or a similar procedure to dry blood samples on filter paper. Regression coefficients of measured and expected values were 0.995 (p < 0.0001) for RBP, 0.989 (p < 0.0001) for STfR, 0.990 (p < 0.0001) for CRP and 0.990 (p < 0.0001) for A1AT.

Conclusions: Our simple drying procedure gave under humid field conditions the same good recovery as DBS which were prepared under laboratory conditions. To avoid problems with DBS we strongly recommend using this or a similar procedure to dry blood samples on filter paper. Regression coefficients of measured and expected values were 0.995 (p < 0.0001) for RBP, 0.989 (p < 0.0001) for STfR, 0.990 (p < 0.0001) for CRP and 0.990 (p < 0.0001) for A1AT.

TU70 BARRIERS TO THE DEVELOPMENT OF A FIELD TOOL TO DETERMINE ANEMIA, IRON DEFICIENCY, INFLAMMATION, AND MALARIA

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1PATH, Seattle, WA, United States, 2University of Washington, Seattle, WA, United States

Background: There is an urgent need for simple, rapid, and field-friendly tools that can be used to identify individuals with anemia who may require iron supplementation. Current tools do not differentiate the cause of the anemia, which is important to know for treating individuals in malaria-endemic regions. A tool that can be used in the field to categorize whether anemia is due to iron deficiency or malaria will have multiple uses particularly in iron supplementation programs in malaria-endemic areas.

Aim: PATH is assessing the feasibility of developing a point-of-collection (POC) tool for assessing anemia, iron deficiency, and malaria status on a single platform. Objectives were to assess the current indicator, and technologies used for measurement of target indicators and the requirements for multiplexing on one diagnostic platform. Our aim is to facilitate the investment required for developing a field tool for use in iron supplementation programs in malaria-endemic areas, during clinical assessment of anemia etiology, and in malaria and hookworm epidemiological surveys interested in causation of anemia.

Method: A literature review on analytes used to measure iron deficiencies as well as hemoglobin, indicators of inflammation, and malaria was undertaken. Online surveys, phone interviews, and desk research were conducted with personnel in nutritional programs and clinicians to define target specifications.

Results: Many indicators are conducive to multiplexing using an immunoassay format such as ferritin, serum transferrin receptor, C-reactive protein, and malaria antigen capture. Zinc protoporphyrin and hemoglobin require significant development for multiplexing into a POC device. Clinical relevance of the POC device exists where automatic analyzers are not in use. Programs measuring iron deficiency vary in which indicators are used.

Conclusions: A major obstacle in development is consensus on which indicators for iron deficiency are appropriate for a POC device. Development of a POC tool for determining anemia, iron deficiency, and malaria is attractive for its multiple uses which will attract private-sector investment for its development. Once these indicators are agreed upon we can move forward to bring this much needed tool to the market.

TU71 THE IMPORTANCE OF CORRECTING FOR INFLAMMATION FOR THE ASSESSMENT OF VITAMIN A DEFICIENCY (VAD)

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Background: vitamin A deficiency (VAD) is a major nutritional problem affecting at least 1.5 billion people worldwide. The prevalence of VAD is determined using different indicators which may be affected by inflammation.

Aim: To estimate VAD using the WHO 2006 criteria more accurately by measuring C-reactive protein (CRP) and correcting RBP measurements for the effect of the acute phase response.

Methods: We analyzed a systematically selected subset of the DBS collected for the WHO 2006 for CRP using enzyme-linked immunosorbent assay (ELISA). CRP had been previously analyzed using the WHO-DA, Subjects were classified into categories of “normal” CRP and “raised” CRP on the basis of a CRP cutoff of 5 mg/L. Correction factors for women and children, respectively, were calculated to remove the influence of infection/inflammation from the RBP values.

Results: Mean CRP was 14.4 mg/L (95% CI: 12.9, 15.9 mg/L) in children and 6.9 mg/L (5.4, 8.0 mg/L) in women. Correction increased mean RBP in women from 25.4 µg/mL (24.7, 26.1 µg/mL) to 27.2 µg/mL (26.5, 28.0 µg/mL) (p < 0.0001). The prevalence of VAD (CRP > 17.3 µg/mL) was reduced from 20.7% to 15.4%. The only Background characteristic that was significantly different between the children in the “healthy” and “raised” CRP groups was rural/urban residence. Among women, mean RBP values for the whole group, “normal” and “raised” CRP were 40.2 µg/mL (38.9, 41.6 µg/mL), 39.8 µg/mL (38.1, 41.5 µg/mL), and 41.0 µg/mL (41.3, 38.6 µg/mL), respectively; the differences were not statistically significant.

Conclusions: Measurement of acute phase proteins removes the influence of inflammation from nutritional biomarkers and could improve population-level assessment of vitamin A status.
TU73

ASSESSMENT OF RETINOL-BINDING PROTEIN AS A SUBSTITUTE FOR SERUM RETINOL IN THE RELATIVE-DOSE-RESPONSE TEST FOR DETERMINING HEPATIC VITAMIN A STORES

Objective: To investigate the influence of inflammation, indicated by CRP and AGP alone and in combination, on FER, sTfR and R/F.

Methods: Serum FER, sTfR, CRP and AGP concentrations were measured in 483 children and 836 women, recruited using PPS-cluster sampling for the 2006 Lao National Maternal and Child Nutrition Survey. Inflammation was identified by elevated CRP (>5 mg/L) and/or AGP (>1 g/L). Subjects were allocated to 4 groups as follows: reference (no raised APP), incubating (raised CRP only), early convalescent (raised AGP only) and late convalescent (both APP raised). Results: Table shows median values. Differences between inflammation groups are indicated by different suffixes. P indicates significance of ANOVA on log-transformed data.

**Table**: Median values of serum ferritin (FER), transferrin receptor (sTfR), C-reactive protein (CRP) and alpha-1-acid glycoprotein (AGP) in children and mothers with different phases of inflammation.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Children</th>
<th>Reference</th>
<th>CRP</th>
<th>AGP</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of mothers</td>
<td>322</td>
<td>788</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ferritin ug/L</td>
<td>38.1a</td>
<td>55.8b</td>
<td>64.4c</td>
<td>44ad</td>
<td>0.001</td>
</tr>
<tr>
<td>sTfR mg/L</td>
<td>3.46a</td>
<td>3.01b</td>
<td>4.74c</td>
<td>4.02c</td>
<td>0.001</td>
</tr>
<tr>
<td>R/F ratio ug/ug</td>
<td>88 a</td>
<td>54.8 b</td>
<td>72 ab</td>
<td>96 a</td>
<td>0.002</td>
</tr>
<tr>
<td>No of children</td>
<td>276</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ferritin ug/L</td>
<td>31 a</td>
<td>44.7 ac</td>
<td>47.5bc</td>
<td>36.7bc</td>
<td>0.003</td>
</tr>
<tr>
<td>sTfR mg/L</td>
<td>4.06 a</td>
<td>4.31 a</td>
<td>4.66bc</td>
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<td>0.027</td>
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<tr>
<td>R/F ratio ug/ug</td>
<td>134a</td>
<td>91 a</td>
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<td>108a</td>
<td>0.095</td>
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Discussion: As expected, ferritin was strongly influenced by inflammation, but so also was sTfR. Ferritin and sTfR increased at different rates and times in the inflammatory response so the R/F ratio was also affected, although this just failed to reach significance (P=0.095) in children. Further studies are needed to clarify the dynamics of the retinol-sTfR molar ratio triggered by the oral dose.}

TU72

IDENTIFYING IRON DEFICIENCY ANEMIA IN DEVELOPING COUNTRY COMMUNITY SETTINGS: RDW WITH HEMOGLOBIN AS AN INVESTIGATIVE TOOL IN PUBLIC HEALTH

Background: Current strategy to identify iron deficiency anemia (IDA) relies on markers like serum ferritin and serum transferrin and zinc protoporphyrin, which are routinely not evaluated due to cost involved. RDW though used in western pediatric practice has not been used in field conditions due to very limited data is available for its sensitivity especially in populations with high malaria prevalence.

Objective: To evaluate the relative diagnostic performance of RDW alone or in combination with hemoglobin as a low cost diagnostic test for identifying IDA.

Methods: We analyzed hematological parameters of 13,702 children aged 2-48 months of Pemba Island (Tanzania). A receiver’s operating characteristic curve (ROC) analysis was performed to examine the sensitivity and specificity of RDW in discriminating IDA. Three gold standard definitions for IDA were used (a) Hb<9 g/dL, (b) Hb<9 g/dL and MCV<70 fL or SFr<12 µg/L; b.) Hb<9 g/dL and MCV<70 fL or SFr<12 µg/L, (c) Hb<9 g/dL and Znppp>80 µmol/mole of heme or MCV<70 fL. A simple algorithm where RDW cut-off obtained from ROC of Pemba Island (Tanzania).

Findings: ROC analysis showed that RDW is a moderately sensitive predictor but not highly specific to identify IDA. The area under the curve was around 0.564 and 0.7150 with the RDR>20% cutoff and the logistic regression probability ≥0.5 cutoff, respectively depending on the cutoff used. RDW-RDR systematically overestimated VA deficiency in higher BMI, although it was clearly superior to a single measurement of serum retinol. The discrepancy between the two forms of RDR appears to originate in a retinol concentration-dependent alteration of the retinol-RBP molar ratio triggered by the oral dose.

Conclusions: In populations with high rates of malaria and infections, RDW in combination with Hb (RDW>40.1 % and Hb<9.0 g/dL) is a highly sensitive and specific predictor of IDA and can be used.

TU74

INFLUENCE OF INFLAMMATION ON SERUM FERRITIN AND TRANSFERRIN RECEPTOR CONCENTRATIONS AND STFR:FER RATIOS IN A NATIONALLY REPRESENTATIVE SAMPLE OF LAO WOMEN AND CHILDREN

Background: Serum ferritin concentration (FER) is a biomarker of iron stores and the serum transferrin receptor (sTfR)/FER ratio (R/F) has been proposed as a simple way of estimating body iron, although not in the presence of inflammation. FER is affected by inflammation while many authors report that sTfR is not. Inflammation can be assessed by measuring two acute phase proteins (APP), C-reactive protein (CRP) and alpha-1-acid glycoprotein (AGP).

Methods: Serum FER, sTfR, CRP and AGP concentrations were measured in 483 children and 836 women, recruited using PPS-cluster sampling for the 2006 Lao National Maternal and Child Nutrition Survey. Inflammation was identified by elevated CRP (>5 mg/L) and/or AGP (>1 g/L). Subjects were allocated to 4 groups as follows: reference (no raised APP), incubating (raised CRP only), early convalescent (raised AGP only) and late convalescent (both APP raised), late convalescent (L, raised AGP only). Results: Table shows median values. Differences between inflammation groups are indicated by different suffixes. P indicates significance of ANOVA on log-transformed data.

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Discussion: As expected, ferritin was strongly influenced by inflammation, but so also was sTfR. Ferritin and sTfR increased at different rates and times in the inflammatory response so the R/F ratio was also affected, although this just failed to reach significance (P=0.095) in children. Further studies are needed to clarify the dynamics of the retinol-sTfR molar ratio triggered by the oral dose.
TU75  EVALUATION OF WHO HEMOGLOBIN COLOR SCALE AND PALMAR PALLOR FOR SCREENING OF ANEMIA AMONG CHILDREN (6-35 MONTHS) IN RURAL WARDHA, CENTRAL INDIA

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Mahatma Gandhi Institute of Medical Sciences, Sewagram, Wardha, Maharashtra, India

Background: Integrated Management of Neonatal and Childhood Illnesses (IMNCI) advocates identification of anemia by observing palmar pallor. Clinical diagnosis by health workers may be inaccurate. As Government of India will also be making Hemoglobin Colour Scale available for use in field under Reproductive and Child Health program – if for screening of antenatal mothers, it can also be used for screening the children. Hence, it becomes imperative to evaluate the performance of both the methods in rural setting.

Objective: To evaluate the performance of Hemoglobin Colour Scale and palmar pallor against filter paper cyanmethemoglobin method as screening methods for anemia in children 6-35 months.

Methodology: 772 children between 6-35 months were studied from three primary health centers of Wardha district, Central India by house to house visit. First of all, the child was examined for presence of palmar pallor as per IMNCI guidelines. Hemoglobin estimation was done by Hemoglobin Colour Scale (HCS) and filter paper cyanmethemoglobin method independently by two persons who were blind to other result.

Results: Hemoglobin color scale had sensitivity of 89% and specificity of 97% in detecting anemia in children. Pallor had sensitivity of 73% and specificity of 98%. The predictive values were 99% and 69% for positive and negative HCS result. Similarly, the predictive values were 99% and 48% for positive and negative pallor result. Correct diagnosis of anemia was 34 and 0.1 times common if HCS test result was positive (Hb ≤ 110.0 gm/L) and negative (Hb > 110.0 gm/L) for anemia.

Conclusion: HCS fulfills the requirement of field test for screening of anemia in resource poor country. It also has acceptable precision and accuracy and hence can be used in national programs such as IMNCI and National Anemia Control Program.
TU76

ANEMIA IN LATIN AMERICA AND THE CARIBBEAN, A SIGNIFICANT PUBLIC HEALTH CHALLENGE

J. Thibodeau, E. Elley, C. Latre, K. Agrawal

Background: Anemia has been documented to be a significant public health problem in most countries of Latin America and the Caribbean (LAC). Over the past decades, LAC countries have established policies and implemented iron supplementation programs to pregnant women and preschool children, iron fortification of wheat flour, and periodic deworming of preschool children.

Aims: To provide updated information on country and regional prevalence of anemia in preschool children and women of childbearing age, as well as on recent trends and estimates of population currently affected.

Methods: In 2008, the Micronutrient Initiative (MI) of Canada and the Pan American Health Organization (PAHO/WHO) completed a compilation and review of reports assessing the prevalence of anemia (hemoglobin adjusted for altitude) in national representative samples of preschool children and women of childbearing age. To provide regional prevalence, World Health Organization (WHO) estimates from the Global Database on Anemia (WHO/RHMS) were used for countries with no national data.

Results: The population weighted average prevalence of anemia in the region amounted to 44.5% in children 6-59 months, 22.2% in non pregnant women and 30.4% in pregnant women. Based on repeated surveys over a 9 to 11-year interval, anemia prevalence has remained unchanged in preschool children (33.2% at baseline versus 33.6% in the last survey) and in non pregnant women (20.3% in 2001 and 22.0%, whereas a significant decline (42.2% versus 28.3%) has occurred in pregnant women. By 2005, the estimated population affected by anemia amounted to nearly 60 million. 23.5 million children ages 6-59 months, 32.2 million non pregnant women, and 3.5 million pregnant women.

Conclusions: Despite ongoing anemia control programs, prevalence estimates remain unchanged, except in pregnant women, thus representing a significant public health challenge. Factors accounting for the little progress thus far in reducing anemia in the region include: insufficient political commitment, weak program management, weak operational and support systems, non systematic behavioral change communication efforts, excess reliance on iron fortification programs and mass fortification of a single food, poor congruence between established goals and reasonable impact expectations, lack of integration of program interventions; and sporadic or non existent program monitoring and evaluation. In order to meet the Millennium Development Goals by 2015, more effective programs need to be implemented in most LAC countries.

TU78

THE SURVEY OF SYNTHESIS NUTRITIONAL SUPPLEMENT ON 3-6 YEARS OLD CHILDREN OF ZINC, VA, VB2, VC DEFICIENCY IN YUGU, DONGXING, BAOAN NATIONALITIES

W. Wangyu, Z. Zhangqiang, S. Sun, M. Majianhua, Z. Zhouyanyuan, L. Liuxudong

Background: Zinc, vitamin A, iron and other micronutrients were in insufficient intake by the way of nutritional education together with multiple nutrients supplementation through the complete nutritional intervention, then to contrastively observe the tampering effect on children, to analyze the dose-effect relationship and to quest the reasonable approach to supplementary.

Objectives: To analyze the intake amounts of Vitamin A, Zinc and other nutrients and the damage responses caused by their insufficient intake through complete nutritional survey (take children aged 3 to 6 lived in the kibitz of Yugu, Dongxing, Baoan nationalities for example). To competitively intervene volunteers whose vitamin A, Zinc and other microminerals were in insufficient intake by the way of nutritional education together with multiple nutrients supplementation through the complete nutritional intervention, then to contrastively observe the tampering effect on children, to analyze the dose-effect relationship and to quest the reasonable approach to supplementary.

Methods: In the survey of zinc, vitamin A, iron and other micronutrients were in insufficient intake by the way of nutritional education together with multiple nutrients supplementation through the complete nutritional intervention, the nutrition education was provided, the amount of zinc, vitamin A, iron and other micronutrients intake were measured, and the reasonable approach to supplementary was sought.

Results: In the survey of zinc, vitamin A, iron and other micronutrients were in insufficient intake by the way of nutritional education together with multiple nutrients supplementation through the complete nutritional intervention, the nutrition education was provided, the amount of zinc, vitamin A, iron and other micronutrients intake were measured, and the reasonable approach to supplementary was sought.

Conclusions: To analyze the intake amounts of Vitamin A, Zinc and other nutrients and the damage responses caused by their insufficient intake through complete nutritional survey (take children aged 3 to 6 lived in the kibitz of Yugu, Dongxing, Baoan nationalities for example) To competitively intervene volunteers whose vitamin A, Zinc and other microminerals were in insufficient intake by the way of nutritional education together with multiple nutrients supplementation through the complete nutritional intervention, then to contrastively observe the tampering effect on children, to analyze the dose-effect relationship and to quest the reasonable approach to supplementary.

Keywords: children aged 3 to 6 of Yugu, Dongxing, Baoan nationalities, vitamin A, Zinc, vitamin B2, comprehensive nutritional intervention

TU77

THE NATIONAL SURVEY OF ANEMIA AND IRON DEFICIENCY IN GEORGIA

G. Giorgadze, I. Choladze, L. Ghvashi, M. Kikia

Introduction: In Georgia several sub-national studies were conducted in recent decade to assess anaemia status in different target groups. Based on the data from these studies, anaemia prevalence significantly increased in all target groups during recent years. In 2007 a national survey of anaemia and iron deficiency among preschool children and women of childbearing age was conducted.

Objectives: The specific objectives are:

- To assess the national estimates of anaemia and iron deficiency in children 2 to 5 years of age and non pregnant women of reproductive age (16-47) to obtain baseline data for later follow up to evaluate the impact of wheat flour fortification efforts on the population of Georgia.

Methods: Proportionate to population size or PPBS based single 30 cluster survey was performed. The target populations to assess iron and anaemia status were children 2 to 5 years of age and non-pregnant women of reproductive age (16-47) as these groups are the most vulnerable to iron deficiency and anaemia. Both target groups were sampled through kindergarten. Serum ferritin and haemoglobin concentrations were measured in women and only haemoglobin concentration was measured in children. The additional information for epidemiological analysis was collected by means of structured interviews using questionnaire.

Results: Total anaemia prevalence in non-pregnant women of reproductive age amounted to 27%, 78% of which (21% of tested sample) proved to be iron deficiency anaemia. Iron deficiency was manifested in 41.4%.

Anaemia prevalence in children 2 to 5 years of age amounted to 26.4%.

Questionnaire survey data analysis revealed direct correlation of iron deficiency with the protein (meat) products poor diet.

Conclusion: Iron deficiency prevalence is alarming. Urgent and unified efforts are required to treat severe iron deficiency, mitigate its consequences, and ensure that they do not reverse or impede progress toward the Millennium Development Goals.

TU79

MAGNITUDE AND CAUSES OF MULTIPLE MICRONUTRIENT DEFICIENCIES AMONG FILIPINO PREGNANT WOMEN

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Methods: A total of 535 pregnant women of the 2003 NMCS with complete data on four biochemical parameters (iron, vitamin A, riboflavin, and folate) that described micronutrient status were included in the study. Serum ferritin and RBC folate were determined by radioimmunoassay (RIA). Serum retinol was determined by high pressure liquid chromatography (HPLC). Erythrocyte glutathione reductase activity coefficient (ECGR-AC) was determined as a measure of riboflavin status. Descriptive statistics: (frequency and percentage distributions, means and proportions/ratios) were computed to provide the micronutrient profile of pregnant mothers. Logistic regression was used to describe the relationship between micronutrient status and the set of independent variables.

Results: Multimicronutrient deficiency was common among pregnant women with only 20.5% not having deficiency in any of the four biochemical indicators. Single micronutrient deficiency was present in 35.6% of the women. 31.3%, 11.4% and 1.1% had concurrent 2, 3 and 4 NMDS. The highest concurrent prevalence of 2 and 3 NMDS was of iron and riboflavin (11.5%), and iron, folate and riboflavin (6.4%). Iron, vitamin A, folate and riboflavin deficiency was present in 1.3%. Gestational age, parity, presence of anaemia and deficiencies of other nutrients were important factors associated with micronutrient deficiencies. Use of vitamin-mineral supplements and education were shown to be associated with lower risk to micronutrient deficiency. In general, energy and nutrient intakes fell below the Philippine Recommended Energy and Nutrient Intake (RENI) of pregnant women. Conclusion and Recommendation: Single and multiple micronutrient deficiencies were prevalent among Filipino pregnant women. Result of this study warrants a need to review the present iron and folate supplementation program of the government to include other micronutrients.

Abstracts
TU81 HYPOMAGNESEMIA: PREVALENCE AND ITS ASSOCIATIONS WITH HYPOCALCEMIA, ZINC DEFICIENCY AND GIARDIA INTESTINALIS IN RURAL TANZANIAN CHILDREN

Kamala K., J. Mbaya*, K. T. Were*, V. Were*, J. Were*

Aims: To assess the prevalence of hypomagnesemia and hypocalcemia, and to evaluate plasma magnesium concentration in relation to plasma concentrations of calcium, zinc and Giardia intestinals infection.

Methods: A community-based survey among children (n=104) aged 6-72 mo in north-eastern Tanzania. Hypomagnesemia was measured as an indicator of magnesium deficiency. Severe hypocalcemia was defined as corrected plasma calcium concentrations whereby admission should be considered according to recent recommendations. Analysis was based on functional polynomial regression.

Results: 21% (95%CI: 16%-26%) of children had severe hypocalcemia. Prevalence values of hypomagnesemia, hypocalcemia, zinc deficiency and Giardia infection were 72% (95%CI: 63%-77%), 59% (94%-64%), 7% (95%CI: 4%-10%) and 38% (95%CI: 27%-49%), respectively. Plasma magnesium concentrations were strongly associated with plasma concentrations of calcium and zinc. In a multivariate model, zinc deficiency and Giardia infection were independently associated with reductions in plasma magnesium concentrations, similar to estimates obtained in univariate analysis. We found no children with vitamin D deficiency.

Conclusions: Magnesium deficiency and hypocalcemia are highly prevalent in the children studied. Our data corroborate our suppositions that deficiencies of magnesium and zinc are due to a low intake of bioavailable magnesium and zinc, respectively, and that magnesium deficiency may induce hypocalcemia. In addition, Giardia infection may interfere with magnesium absorption. Randomised controlled trials are needed to confirm these observations and to further evaluate functional consequences of magnesium deficiency in African children.

TU82 IRON AND VITAMIN A STATUS IN PAPUA NEW GUINEA: RESULTS OF A 2005 NATIONAL SURVEY


Aims: To determine the prevalence of iron and vitamin A deficiency in Papua New Guinea (PNG), and to assess the associations with other factors that may affect these deficiencies.

Methods: A cross-sectional survey with a final sample size of 280 children aged 6-36 months and 273 non-pregnant, non-lactating women of reproductive age (WRA) in Eastern Samar, and 280 children and 277 WRA in Iloilo. Anemia was defined by blood Hb concentration (Hb) measured using HemoCue® instrument. Biological parameters included plasma ferritin as indicator of iron deficiency, C-reactive protein (CRP) and α1-acid glycoprotein AGP as indices of infection, parasitism, malaria status and folate levels among WRA.

Results: Anemia defined as Hb concentration below 11.0 g/dL was observed in 61% of children (age 6-36 months) and 55% of WRA. Prevalence of iron deficiency was 35% in children and 22% in WRA. Anemia, iron deficiency and malaria were found to be predictors of vitamin A status. In both groups, vaccination against poliomyelitis was also a significant predictor, with parasitism as a major contributory factor among children and vitamin A status in both target groups. In terms of the national status, the prevalence of children and WRA was 46% and 38%, respectively. Among individuals with vitamin A deficiency, 30% had received supplementary vitamin A and 10% had received prophylactic antibiotics.

Conclusions: Anemia is a public health concern that needs immediate attention. Its causes are multifactorial that requires a mix of interventions and a multi-stakeholder strategic cooperation. The variations across target groups call for group specific integrative approaches.

TU80 ANAEMIA - AN EPIDEMIC IN INDIA

Saxena S., V. Saxena2, N. Namshum1

Aims: To estimate the prevalence of anemia and iron deficiency in India, and to assess the associations with other factors that may affect these deficiencies.

Methods: A national survey was conducted in 2005-06. Hemoglobin was measured using capillary blood in all participants; the proportionate to population size (PPS) sampling method was used. Prevalence of anemia was defined as blood Hb concentration below 12.0 g/dL among non-pregnant, non-lactating children aged 6-59 months and 21.0 g/dL among women aged 18 years and older. Hemoglobin concentration was measured using a portable instrument.

Results: Anemia was defined as blood Hb concentration below 11.0 g/dL among 6-36 month-old children and 10.1 g/dL among 6-18 month-old children. Anemia was defined as blood Hb concentration below 11.0 g/dL among children aged 6-36 months and 273 non-pregnant, non-lactating women of reproductive age (WRA) in Eastern Samar, and 280 children and 277 WRA in Iloilo. Anemia was defined as blood Hb concentration below 11.0 g/dL among children aged 6-36 months and 273 non-pregnant, non-lactating women of reproductive age (WRA).

Conclusions: Anemia is a public health concern that needs immediate attention. Its causes are multifactorial that requires a mix of interventions and a multi-stakeholder strategic cooperation. The variations across target groups call for group specific integrative approaches.

TU83 ANAEMIA SITUATION IN TWO PHILIPPINE PROVINCES: IMPLICATIONS FOR THE DEVELOPMENT OF AN INTEGRATED ANAEMIA PREVENTION AND CONTROL PROGRAMME

J. A. T. T. Antion, R. Caballero, L. Ayu

Aims: To determine the magnitude and biological factors associated with anaemia in UNICEF’s Country Programme for Children (CPC) provinces of Eastern Samar and Iloilo.

Methods: A cross-sectional study with a final sample size of 380 children aged 6-36 months and 273 non-pregnant, non-lactating women of reproductive age (WRA) in Eastern Samar, and 280 children and 277 WRA in Iloilo. Anemia was defined by blood Hb concentration (Hb) measured using HemoCue® instrument. Biological parameters included plasma ferritin as indicator of iron deficiency, C-reactive protein (CRP) and α1-acid glycoprotein (AGP) as indices of infection, parasitism, malaria status and folate levels among WRA.

Results: Anemia defined as blood Hb concentration below 11.0 g/dL among children aged 6-36 months and 273 non-pregnant, non-lactating women of reproductive age (WRA) was present in both provinces and target groups. In both target groups, prevalence of anaemia was 60% among children and 59% among WRA. Iron deficiency was the main determinant of anaemia among children in both provinces. Iron and folate deficiencies on the other hand explained anaemia among pregnant women in Eastern Samar, but folate deficiency was found to be a predictor of anaemia status among WRA in Iloilo. In both target groups in the two provinces, anemia was also identified as a significant factor, with parasitism as a major contributory factor among children and WRA in Eastern Samar.

Conclusions: Anemia is a public health concern that needs immediate attention. Its causes are multifactorial that requires a mix of interventions and a multi-stakeholder strategic cooperation. The variations across target groups call for group specific integrative approaches.
EVIDENCE-BASED PROGRAMS

**W01**

**EFFECTS OF ANTENATAL MULTIPLE MICRONUTRIENT SUPPLEMENTATION ON CHILDREN’S WEIGHT AND SIZE AT 2 YEARS OF AGE IN NEPAL**

P Linnan, S Spratt, S Sathiyasundaram, D Muirhead, D Marques, M. O’Toole

**Abstract**

Background: Associations of low birthweight with the later health of children in developing countries have been demonstrated consistently. However, undertaking programmes to address this issue can be difficult due to persistent gaps in understanding the relationship between increasing birthweight and improving child health. In 2005, we reported that antenatal multiple micronutrient supplementation during the second and third trimesters of pregnancy increased birthweight in a double-blind, randomized controlled trial. Here, we assessed the effect on children at 2–3 years of age born during the trial.

**Objectives:** To assess the long-term effects of antenatal multiple micronutrient supplementation on weight and height of children born during the trial, at 2–3 years of age.

**Methods:** Anthropometric measurements were made on children born to mothers in the trial. The primary outcomes were weight and height.

**Findings:** At a mean age of 2.2 years, 977 children (45% control, 46% intervention) were successfully followed up. Mean birthweight had been 77.9 g (95% CI, 28.0–132) greater in the micronutrient group than in controls. Children of women who had taken multiple micronutrient supplements during pregnancy were 2.04 (95% CI, 0.27–3.81) heavier than controls. They also had greater measurements than controls in the circumference of the head (2.4 mm; 95% CI, 0.6–4.3), chest (5.2 mm; 0.4–10.1), and mid-upper arm (2.4 mm; 1.1–3.7), and in triceps skinfold thickness (2.4 mm; 0.4–4.4). Systolic blood pressure was slightly lower in the intervention group (2.5 mm Hg; 0.5–4.4).

**Interpretation:** In a poor population, the effects of maternal multiple micronutrient supplementation on the fetus were maintained into childhood in terms of weight and body size. The public-health implications of changes in weight and blood pressure need to be clarified through further follow-up.

**W02**

**ANTENATAL IRON SUPPLEMENTATION REDUCES CHILDHOOD MORTALITY IN RURAL NEPAL**

**Abstract**

Background: Iron deficiency and anemia during pregnancy can cause low birthweight, preterm birth and increase the risk of perinatal mortality, but the long-term benefits of iron supplementation during pregnancy on the fetus were maintained into childhood in terms of weight and body size. The public-health implications of changes in weight and body size are unclear through further follow-up.

**Objectives:** To assess the long-term effects of antenatal multiple micronutrient supplementation on weight and height of children born during the trial, at 2–3 years of age.

**Methods:** Anthropometric measurements were made on children born to mothers in the trial. The primary outcomes were weight and height.

**Findings:** At a mean age of 2.2 years, 977 children (45% control, 46% intervention) were successfully followed up. Mean birthweight had been 77.9 g (95% CI, 28.0–132) greater in the micronutrient group than in controls. Children of women who had taken multiple micronutrient supplements during pregnancy were 2.04 (95% CI, 0.27–3.81) heavier than controls. They also had greater measurements than controls in the circumference of the head (2.4 mm; 95% CI, 0.6–4.3), chest (5.2 mm; 0.4–10.1), and mid-upper arm (2.4 mm; 1.1–3.7), and in triceps skinfold thickness (2.4 mm; 0.4–4.4). Systolic blood pressure was slightly lower in the intervention group (2.5 mm Hg; 0.5–4.4).

**Interpretation:** In a poor population, the effects of maternal multiple micronutrient supplementation on the fetus were maintained into childhood in terms of weight and body size. The public-health implications of changes in weight and blood pressure need to be clarified through further follow-up.

**W03**

**EFFECTS OF ANTENATAL MULTICLORINUTRIENT SUPPLEMENTATION ON GROWTH, BODY COMPOSITION AND EARLY MARKERS OF CARDIOVASCULAR RISK AMONG 7 YEAR OLD CHILDREN IN RURAL NEPAL**

**Abstract**

P Christian, C Stewart, S LeClerq, S Shrestha, L Wu, K West Jr, S Khatry

**Objectives:** To assess the effect of antenatal multiple micronutrient supplementation on weight and height of children born during the trial, at 2–3 years of age.

**Methods:** Anthropometric measurements were made on children born to mothers in the trial. The primary outcomes were weight and height.

**Findings:** At a mean age of 2.2 years, 977 children (45% control, 46% intervention) were successfully followed up. Mean birthweight had been 77.9 g (95% CI, 28.0–132) greater in the micronutrient group than in controls. Children of women who had taken multiple micronutrient supplements during pregnancy were 2.04 (95% CI, 0.27–3.81) heavier than controls. They also had greater measurements than controls in the circumference of the head (2.4 mm; 95% CI, 0.6–4.3), chest (5.2 mm; 0.4–10.1), and mid-upper arm (2.4 mm; 1.1–3.7), and in triceps skinfold thickness (2.4 mm; 0.4–4.4). Systolic blood pressure was slightly lower in the intervention group (2.5 mm Hg; 0.5–4.4).

**Interpretation:** In a poor population, the effects of maternal multiple micronutrient supplementation on the fetus were maintained into childhood in terms of weight and body size. The public-health implications of changes in weight and blood pressure need to be clarified through further follow-up.

**W04**

**MATERNAL VITAMIN A SUPPLEMENTATION DURING PREGNANCY IMPROVES LUNG FUNCTION IN A COHORT OF PRE-ADOLESCENT CHILDREN IN RURAL NEPAL**

**Abstract**


**Objectives:** To assess the effect of antenatal multiple micronutrient supplementation on weight and height of children born during the trial, at 2–3 years of age.

**Methods:** Anthropometric measurements were made on children born to mothers in the trial. The primary outcomes were weight and height.

**Findings:** At a mean age of 2.2 years, 977 children (45% control, 46% intervention) were successfully followed up. Mean birthweight had been 77.9 g (95% CI, 28.0–132) greater in the micronutrient group than in controls. Children of women who had taken multiple micronutrient supplements during pregnancy were 2.04 (95% CI, 0.27–3.81) heavier than controls. They also had greater measurements than controls in the circumference of the head (2.4 mm; 95% CI, 0.6–4.3), chest (5.2 mm; 0.4–10.1), and mid-upper arm (2.4 mm; 1.1–3.7), and in triceps skinfold thickness (2.4 mm; 0.4–4.4). Systolic blood pressure was slightly lower in the intervention group (2.5 mm Hg; 0.5–4.4).

**Interpretation:** In a poor population, the effects of maternal multiple micronutrient supplementation on the fetus were maintained into childhood in terms of weight and body size. The public-health implications of changes in weight and blood pressure need to be clarified through further follow-up.
THE EXTENDED IMPACT OF PRESCHOOL VITAMIN A SUPPLEMENTATION ON YOUNG ADULT HEARING LOSS IN SOUTHERN NEPAL

Abstract on hearing loss in young adult life.

Methods: Vitamin A deficiency has been associated with hearing loss in animal models and human observations. Middle ear infections (OM) during childhood are a leading cause of hearing loss. Yet, the effect of vitamin A supplementation in reducing severity of otitis media and consequent hearing loss has never been studied in human populations.

Objective: To evaluate the possible long-term effects of preschool vitamin A supplementation on hearing loss in young adult life.

Methods: Hearing ability was assessed in 2,463 young adults 16-23 years of age living in the rural community of Sauraha in the central region of Nepal between 2006 and 2008. Subjects represented 74% of surviving, resident participants of an initial cohort of children who, in their preschool years, participated in a cluster-randomized, vitamin A supplementation trial from 1989 through 1991. In the original trial, over a 16-month period, children were dosed with 200,000 IU vitamin A a placebo every four months (five times). At each visit, parents were asked about the number of days in the previous week children were observed to have ear discharge (indicating otitis media) and other morbidity symptoms. In the follow-up health assessments, audometric evaluations were done in addition to nutritional and socioeconomic assessments. Hearing loss was defined using an air conduction threshold value greater than 30 dB in the worse ear across the frequencies 0.5, 1, 2, and 4 kHz.

Results: There was evidence of modest strength that vitamin A supplementation in early childhood decreased the risk of hearing loss (OR=0.89, 95% CI: 0.66, 1.17), reflecting a 20% reduction in population risk. Reporting any ear discharge in the preschool years was strongly associated with later hearing loss (OR=5.80, 95% CI: 4.05, 8.36), providing validity to this history obtained during childhood.

Conclusion: The main aim of the program was to increase the coverage and compliance of iron supplementation, thereby reduce Anemia in pregnant women. As per the policy, pregnant women have to take the supplement from the 2nd trimester of pregnancy to 45 days postpartum.

Methods: In order to improve the access, Female Community Health Volunteer (FCHV) were trained to distribute the iron supplements. With supportive supervision from health system, a strong monitoring system was put in place by using community based distribution of iron supplements, strong monitoring of pregnant women, awareness creation, improved logistics supply and promotion of complementary measures has led to significant reduction in anemia. Aims: To respond to this situation, UNICEF is supporting the Ministries of Health and Education in implementing large-scale anemia control programs for adolescent girls in 13 States.

Framework: School girls are being reached through the Integrated Child Development Scheme program. Outcomes: Coverage data show that about nine million girls are being reached. Preliminary results show decreases in the prevalence of anemia among adolescent girls ranging from 5% to 30 percentage points, after one year, and up to 70 percentage points, after two years. Smear ferritin (SF) data collected in one state at baseline and one year after the beginning of program implementation show a decrease in iron deficiency (SF < 15 pg/mL) in 50% to 31% suggesting a positive effect of the program on the body iron stores of adolescent girls. Compliance with iron and folic acid supplementation is about 90 percent in most states. Side effects (mainly black stools, nausea and vomiting) were reported by more girls at the beginning of the program than a few months later (from 50 percent to 2 percent respectively in one of the programs). More than 80% of girls reported health, nutrition, and well-being benefits since the beginning of the program, which they attributed to the supplementation. The average cost per adolescent girl per year ranges between US$ 0.30 and US$ 0.90. The costs include supplies, training, communication, monitoring, and evaluation. Implications: State and Central Governments are now taking the lead in funding and scaling these programs, while UNICEF continues to support State Governments’ efforts in 7 states in India to reach an additional 4 million girls over the next two years.

Key words not in the title: iron, folic acid, deworming, school girls, out of school girls.

IRON/FOLIC ACID SUPPLEMENTS PROTECT AGAINST EARLY NEONATAL MORTALITY IN INDONESIA

Background: Neonatal mortality is the major contributor to infant deaths in low and middle income countries and identifying effective interventions will be crucial to achieving the infant survival Millennium Development Goals. This study examined the relationship between antenatal care, iron/folic acid supplements and TT vaccinations and the risk of early neonatal mortality in Indonesia.

Methods: Pooled data from the Indonesia Demographic and Health Surveys of 1994, 1997 and 2002 were analyzed, using the neonatal survival information from all singleton live born infants of the mothers’ most recent birth within five years of the survey. We examined the relationship between the use of antenatal care and its components of any iron/folic acid supplements and TT vaccination, and early neonatal mortality (0-7 days) using multivariate Cox proportional hazards models controlling for delivery attendance, birth size, reported duration of pregnancy, delivery complications, Child sex, maternal education, household wealth index, and year of survey. The results are presented as hazard ratios (HR) and 95% confidence intervals adjusted for the cluster sampling design.

Findings: Neonatal survival information was available from 40,557 singleton live born infants from which there were 442 early neonatal deaths. After adjustment for potential confounding factors, we found the risk of early neonatal deaths was reduced significantly for mothers receiving any antenatal care (HR=0.48, 95% CI:0.31–0.73), consuming any iron/folic acid supplements during pregnancy (HR=0.50, 95% CI:0.36–0.72) and receiving two or more TT vaccinations (HR=0.66, 95% CI:0.48–0.92). An assessment of combinations of these services revealed that the main protective effect was from iron/folic acid supplements. Infants whose mothers received only iron/folic acid supplements without receiving ANC (HR=0.10, 95% CI:0.01–0.67) or TT vaccination (HR=0.46, 95% CI:0.29–0.73) remained significantly protected from neonatal death. Assuming a causal association, 20% of early neonatal deaths in Indonesia could be attributed to lack of iron/folic acid supplementation during pregnancy.

Interpretation: Increased use of iron/folic acid supplements among pregnant women will reduce early neonatal mortality in Indonesia, and in other low and middle income countries. It should be recognized as a key component in any package of services to prevent neonatal deaths.

W06 NEPAL DRASTICALLY REDUCES THE PREVALENCE OF ANEMIA IN PREGNANT WOMEN IN THE PAST SEVEN YEARS FROM 75% TO 42%

Background: Anemia among pregnant women in Nepal was alarmingly high at 75% in 1998 and coverage of iron/folic acid (IFA) supplementation was only 23% with negligible compliance in 2001. The National Anemia Control Strategy and iron Intensification Program was developed in 2001, with a key focus to increase the coverage and compliance of iron supplementation along with complementary measures such as deworming of pregnant women and dietary diversification, food and maternal care practices. The current framework started the program with free distribution in 2003 and has expanded to 52 districts in all 2008 with the support from Micronutrient Initiative (MI), UNICEF and WHO. The Government aims to cover all 75 districts by 2010.

Aims: The main goal of the programs was to increase the coverage and compliance of iron supplementation, thereby reduce Anemia in pregnant women. As per the policy, pregnant women have to take the supplement from the 2nd trimester of pregnancy to 45 days postpartum.

Methods: In order to improve the access, Female Community Health Volunteer (FCHV) were trained to distribute the iron supplements. With supportive supervision from health system, a strong monitoring system was put in place by using community based distribution of iron supplements, strong monitoring of pregnant women, awareness creation, improved logistics supply and promotion of complementary measures has led to significant reduction in anemia. Aims: To respond to this situation, UNICEF is supporting the Ministries of Health and Education in implementing large-scale anemia control programs for adolescent girls in 13 States.

Framework: School girls are being reached through the Integrated Child Development Scheme program. Outcomes: Coverage data show that about nine million girls are being reached. Preliminary results show decreases in the prevalence of anemia among adolescent girls ranging from 5% to 30 percentage points, after one year, and up to 70 percentage points, after two years. Smear ferritin (SF) data collected in one state at baseline and one year after the beginning of program implementation show a decrease in iron deficiency (SF < 15 pg/mL) in 50% to 31% suggesting a positive effect of the program on the body iron stores of adolescent girls. Compliance with iron and folic acid supplementation is about 90 percent in most states. Side effects (mainly black stools, nausea and vomiting) were reported by more girls at the beginning of the program than a few months later (from 50 percent to 2 percent respectively in one of the programs). More than 80% of girls reported health, nutrition, and well-being benefits since the beginning of the program, which they attributed to the supplementation. The average cost per adolescent girl per year ranges between US$ 0.30 and US$ 0.90. The costs include supplies, training, communication, monitoring, and evaluation. Implications: State and Central Governments are now taking the lead in funding and scaling these programs, while UNICEF continues to support State Governments’ efforts in 7 states in India to reach an additional 4 million girls over the next two years.

Key words not in the title: iron, folic acid, deworming, school girls, out of school girls.

LARGE SCALE MULTI-STATE ANEMIA CONTROL PROGRAM FOR ADOLESCENT GIRLS IN INDIA

Background: Anemia remains a major public health problem even though its detrimental consequences on human and national development are well documented. It is increasingly recognized that the effective control of anemia requires a life cycle approach, in which the period of adolescence—particularly among girls—is crucially important. However, programs designed specifically to prevent anemia among adolescent girls are still scarce. In India, recent data indicate that 90 percent of adolescent girls are anemic. To respond to this situation, UNICEF is supporting the Ministries of Health and Education in implementing large-scale anemia control programs for adolescent girls in 13 States.

Aims: To reduce the prevalence of anemia in school going and out of school adolescent girls through weekly iron and folic acid supplementation coupled with twice yearly deworming (albendazole) and regular provision of factual information, education and communication for the prevention of anemia.

Framework: School girls are supported under the supervision of teachers. Out of school girls are reached through the Integrated Child Development Scheme program. Outcomes: Coverage data show that about nine million girls are being reached. Preliminary results show decreases in the prevalence of anemia among adolescent girls ranging from 5% to 30 percentage points, after one year, and up to 70 percentage points, after two years. Smear ferritin (SF) data collected in one state at baseline and one year after the beginning of program implementation show a decrease in iron deficiency (SF < 15 pg/mL) in 50% to 31% suggesting a positive effect of the program on the body iron stores of adolescent girls. Compliance with iron and folic acid supplementation is about 90 percent in most states. Side effects (mainly black stools, nausea and vomiting) were reported by more girls at the beginning of the program than a few months later (from 50 percent to 2 percent respectively in one of the programs). More than 80% of girls reported health, nutrition, and well-being benefits since the beginning of the program, which they attributed to the supplementation. The average cost per adolescent girl per year ranges between US$ 0.30 and US$ 0.90. The costs include supplies, training, communication, monitoring, and evaluation. Implications: State and Central Governments are now taking the lead in funding and scaling these programs, while UNICEF continues to support State Governments’ efforts in 7 states in India to reach an additional 4 million girls over the next two years.

Key words not in the title: iron, folic acid, deworming, school girls, out of school girls.
W09 REFLECTIONS ON LESSONS LEARNED SINCE 2004 FROM THE SOUTH AFRICAN FLOUR FORTIFICATION PROGRAMME

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**Background:** Studies conducted in the 1990s showed that micronutrient malnutrition is highly prevalent in South Africa, e.g., marginal vitamin A deficiency occurred in 33.3% of children aged 6–71 months and 21.4% were found to be anaemic. As a result, the Government adopted Food Fortification as one of the strategies to address micronutrient malnutrition in the country.

**Aims:** To share the key lessons learned in South Africa in implementation of a large scale flour fortification programme since promulgation of mandatory regulations.

**Methods:** The oversight management of the programme was under the National Fortification Alliance, a multi-disciplinary body including milling and bakery industry representation. The programme was evidence based with several compliance monitoring and feasibility assessment such as the compliance monitoring of fortification mixes, and a national situation assessment on micronutrient levels. Environmental Health Training was available for compliance monitoring were trained. Communication campaigns were implemented to create awareness and the Department of Trade and Industry (DTI) made available a grant to the manufacturers for the purchasing and installation of equipment. Documentation of key issues, lessons learned and challenges experienced throughout the process has been of pivotal importance.

**Results:** The aim was to expand the national food fortification programme with, to fortify a widely consumed staple food(s) with key micronutrients at levels which would improve micronutrient status, whilst not causing unacceptable organoleptic changes and/or an unaffordable price increase of the final product. The mandatory fortification of all maize meal and white and brown rice flour came into effect on 7 October 2003. The fortification in the fortification mix (per kg) for maize meal and bread flour respectively am- sodium ascorbate (139 g, 119 g), thiamine mononitrate (16 g, 11.1g), riboflavin (9.4 g, 8 g), niacinamide (125 g, 118.4 g), pyridoxine HC1 (19.3 g, 16.4 g), folic acid (11.1 g, 7 g); electrolyte iron (178.7 g, 178.6 g) and zinc oxide (14.9 g, 19.9 g). The Fortification Programme has resulted in a 30.5% decrease in Neural Tube Defects in the country. However, a national cross-sectional survey conducted in 2005 has not shown a reduction in vitamin A and iron deficiencies.

**Conclusion:** Although implementation of the programme has been successful, key lessons have been learnt and continue to be learnt. Communication efforts should have been more emphatic on food fortification logo recognition and the benefits derived from this programme. Smaller scale studies to assess the biological impact of the programme should have been commissioned rather than national large scale assessments. Intensified measures should have been undertaken to ensure that the small and medium sized mills are motivated to apply for the DTI funds. Acceleration of compliance monitoring and quality assurance of fortification mixes should have taken place earlier than the Memorandum of Understanding between the Department of Health and the South African Bureau of Standards. Currently the progress should be on evaluation of the types of fortification food, feasibility and costing of a more bioavailable iron compound and continuance of the communication campaign.

W11 DUAL FORTIFICATION OF SALT WITH IODINE AND IRON: A RANDOMIZED, DOUBLE BLIND, CONTROLLED TRIAL IN SOUTHERN INDIA OF MICRONIZED FERRIC PYROPHOSPHATE AND ENCAPSULATED FERRUMUM FUMARATUM

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**Background:** Dual fortification of salt with iodine and iron could be an effective and sustainable approach to combating iodine and iron deficiencies. Two promising alternative approaches for DFS have been proposed.

**Objective:** We compared the efficacy of two contrasting DFS formulas, one containing fortification iron as micronized ground ferric pyrophosphate (MGFePP) and the other as encapsulated ferric fumarate (EFF), to that of iodized salt (IS) in school children in rural southern India with optimal iodine nutrition but low iron stores.

**Design:** A randomized, double-blind, controlled intervention was conducted in 1.5–5-year-old children (n=608) randomly assigned into 3 groups to receive IS or DFS with iron as MGFePP or EFF, both at a level of 2 mg/g of salt. The salts were distributed directly to the participating households for 10 mos. We measured hemoglobin, iron status and urinary iodine at baseline, 5 mos and 10 mos.

**Results:** Median serum ferritin (SF) and calculated median body iron improved significantly in the two groups receiving iron. After 10 mos, the prevalence of anaemia decreased from 16.0 to 7.7% in the MGFePP group (P < 0.05) and from 15.1 to 5.0% in the EFF group (P < 0.01). The median urinary iodine concentration increased significantly in the IS and EFF groups (P < 0.001) but not in the MGFePP group. Levels of iodine in 1.1% mixture salt were high for MGFePP while the EFF benzated in 0.1% mixture salt and caused color changes in some local foods.

**Conclusion:** Both DFS were efficacious in reducing the prevalence of anemia and iron deficiency in school-age children. Local salt characteristics should be taken into consideration when choosing an iron fortificant for DFS to achieve optimal iodine stability and color.

W10 CONSUMPTION OF NAFEDETA FORTIFIED WHEAT FLOUR IMPROVES BODY IRON STORES IN URBAN INDIAN SCHOOL CHILDREN

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**Background:** Wheat is one of the main staple foods in India. Fortification of wheat flour with NaFeEDTA, a highly bioavailable iron (Fe) fortificant that protects Fe from the phytic acid present in the flour, could be an effective strategy for controlling iron deficiency in the region.

**Aims:** To evaluate the efficacy of NaFeEDTA-fortified whole wheat flour in reducing iron deficiency and improving body iron stores and intellectual performance in urban, school-going Indian children.

**Methods:** A randomized, double-blind, 7 month, school-based feeding trial was carried out in Bangalore, India. In-depended, 6–11 year old children (n=194) were randomly assigned to either receive a whole wheat flour-based lunch meal fortified with 6 mg Fe as NaFeEDTA or an identical unfortified control meal. The meals were administered under supervision and left over meals were weighed. Hemoglobin (Hb) and iron status were measured at baseline, 3.5 months, and 7 months. At baseline and at 7 months, the study children were also subjected to a battery of cognitive tests to assess short term memory, attention, concentration, reasoning, visuo-spatial abilities and long term memory. Sensory evaluation using triangle tests were carried out using meals prepared from the fortified and unfortified wheat flour.

**Results:** At baseline, the prevalence of iron deficiency and iron deficiency anaemia (IDA) in the entire sample were 66% and 17%, respectively. Over 7 months, the prevalence of Fe deficiency and IDA significantly decreased from 66% to 22% and from 18% to 7%, respectively, in the iron-fortified group, but not in the control group. Time X treatment interactions were significant for Hb, SF and total body iron (A<0.001). Body iron stores were greater in the iron-fortified group when compared to the control group (2.4 vs 0.6 mg/kg body wt) after 7 months (P<0.001). Iron fortification also markedly improved Hb, SF and TfR1 greater in the iron-fortified group when compared to the control group (2.4 vs -0.6 mg/kg body wt).

**Conclusion:** Iron fortification significantly improved body iron stores and reduced the prevalence of Fe-deficiency and can be recommended for use in school feeding programs for children.
W13  FERROUS FUMARATE AND FERRUS PYROPHOSPHATE ARE AS USEFUL AS FERRUS SULFATE TO PREVENT ANEMIA IN INFANTS AND YOUNG CHILDREN IN DEVELOPING COUNTRIES

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Background: The Philippines is presently implementing a Food Fortification Program (FFP) based on the National Food Fortification Strategic Plan for 2004-2010. The FFP is expected to contribute significantly to the prevention of anemia and iron deficiency in infants and young children. This study reports on the iron absorption from ferrous fumarate and ferrous pyrophosphate.

Methods: 235 non anemic (Hb >105 g/L) children (2-5 yr) and adult women were randomly assigned to receive either 4 mg Fe (women) or 2.3 mg Fe (infants and young children) as either [57Fe]-fumarate or [58Fe]-ferrous sulfate added to a sweetened drink based on degermed maize flour and milk powders. Iron absorption was calculated based on incorporation of isotopic iron isotopes into erythrocytes.

Conclusions: To evaluate the efficacy of ferrous fumarate and ferrus pyrophosphate, as compared to ferrous sulfate, to prevent the development of anemia in non-anemic Bangladeshi infants and young children. For rice to be an effective delivery vehicle for iron, it has to be white in color, meeting the regulatory and operational specifications and industry standards. Dietary intake, biochemical indicators and anthropometric indices were measured at baseline, 4.5 months (0-5.6 %; p=0.96), 9 months (0.3-11.4 %; p=0.65), 13 months (21.5-27.8 %; p=0.13), and at 27 months (2.9-5.8 %; p=0.05). Iron absorption was calculated based on incorporation of isotopic iron isotopes into erythrocytes.

Objectives: To compare iron absorption from ferrous fumarate and ferrous sulfate in infants, young children and mothers. To determine if iron deficiency is ameliorated by the fortification strategy. To evaluate the efficacy of ferrous fumarate and ferrus pyrophosphate, as compared to ferrous sulfate, to prevent the development of anemia in non-anemic Bangladeshi infants and young children. For rice to be an effective delivery vehicle for iron, it has to be white in color, meeting the regulatory and operational specifications and industry standards. Dietary intake, biochemical indicators and anthropometric indices were measured at baseline, 4.5 months (0-5.6 %; p=0.96), 9 months (0.3-11.4 %; p=0.65), 13 months (21.5-27.8 %; p=0.13), and at 27 months (2.9-5.8 %; p=0.05). Iron absorption was calculated based on incorporation of isotopic iron isotopes into erythrocytes.

Conclusions: No statistically significant difference was observed between the intervention groups in the proportion of children developing anemia (Hb <105 g/L) from baseline to 4.5 months (17.8-21.7 %) or from 4.5 months until the end of the study (5.9-9.4 %) (Pearson’s Chi-Square test), nor in the change in hemoglobin concentration from baseline to 4.5 months or to 9 months (Kruskal-Wallis test). No statistically significant difference was observed between the 3 groups in the percentage of children with low plasma ferritin (<12 ug/L) at baseline (21.7-26.8 %, p=0.36), 4.5 months (0.5-6.6 %, p=0.15) or at 9 months (0.4-12.3 %, p=0.65). Pearson’s Chi-Square test) nor in the % of children with elevated plasma TFR (>8.5 mg/L) at baseline (p=0.21) or at 4.5 months (p=0.96). Pearson’s Chi-Square test). At 9 months, none of the children had elevated TFR concentration. No statistically significant differences were observed in the % children with elevated TFR concentration (>10 mg/L) between groups.

W15  A COMPARISON OF THE BIOAVAILABILITY OF FERROUS FUMARATE AND FERROUS SULFATE IN NON ANEMIC MEXICAN WOMEN AND CHILDREN CONSUMING A SWEETENED MAIZE AND MILK DRINK

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Background: The Philippines is presently implementing a Food Fortification Program (FFP) based on the National Food Fortification Strategic Plan for 2004-2010. The FFP is expected to contribute significantly to the prevention of anemia and iron deficiency in infants and young children. For rice to be an effective delivery vehicle for iron, it has to be white in color, meeting the regulatory and operational specifications and industry standards. Dietary intake, biochemical indicators and anthropometric indices were measured at baseline, 4.5 months (0-5.6 %; p=0.96), 9 months (0.3-11.4 %; p=0.65), 13 months (21.5-27.8 %; p=0.13), and at 27 months (2.9-5.8 %; p=0.05). Iron absorption was calculated based on incorporation of isotopic iron isotopes into erythrocytes.

Methods: A double-blind study with 235 non anemic (Hb >105 g/L) children (7-24 months) randomized into 3 groups. One serving of iron fortified infant cereal (0.3 mg iron/ serving, ascorbic acid:iron molar ratio 3:1) was consumed per day, 6 days/week, during 9 months. Blood samples were drawn at 4.5 months and 9 months and analyzed for Hb, plasma ferritin, plasma TFR and plasma CRP.

Results: No statistically significant difference was observed between the groups of children developing anemia (Hb <105 g/L) from baseline to 4.5 months (17.8-21.7 %) or from 4.5 months until the end of the study (5.9-9.4 %) (Pearson’s Chi-Square test), nor in the change in hemoglobin concentration from baseline to 4.5 months or to 9 months (Kruskal-Wallis test). No statistically significant difference was observed between the 3 groups in the percentage of children with low plasma ferritin (<12 ug/L) at baseline (21.7-26.8 %, p=0.36), 4.5 months (0.5-6.6 %, p=0.15) or at 9 months (0.4-12.3 %, p=0.65). Pearson’s Chi-Square test) nor in the % of children with elevated plasma TFR (>8.5 mg/L) at baseline (p=0.21) or at 4.5 months (p=0.96). Pearson’s Chi-Square test). At 9 months, none of the children had elevated TFR concentration. No statistically significant differences were observed in the % children with elevated TFR concentration (>10 mg/L) between groups.

Conclusions: No statistically significant difference was observed between the intervention groups in the proportion of children developing anemia (Hb <105 g/L) from baseline to 4.5 months (17.8-21.7 %) or from 4.5 months until the end of the study (5.9-9.4 %) (Pearson’s Chi-Square test), nor in the change in hemoglobin concentration from baseline to 4.5 months or to 9 months (Kruskal-Wallis test). No statistically significant difference was observed between the 3 groups in the percentage of children with low plasma ferritin (<12 ug/L) at baseline (21.7-26.8 %, p=0.36), 4.5 months (0.5-6.6 %, p=0.15) or at 9 months (0.4-12.3 %, p=0.65). Pearson’s Chi-Square test) nor in the % of children with elevated plasma TFR (>8.5 mg/L) at baseline (p=0.21) or at 4.5 months (p=0.96). Pearson’s Chi-Square test). At 9 months, none of the children had elevated TFR concentration. No statistically significant differences were observed in the % children with elevated TFR concentration (>10 mg/L) between groups.

W14  THE PHILIPPINE RICE FORTIFICATION PROGRAM

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Background: The Philippines is presently implementing a Food Fortification Program (FFP) based on the National Food Fortification Strategic Plan for 2004-2010. The FFP is expected to contribute significantly to the prevention of anemia and iron deficiency in infants and young children. For rice to be an effective delivery vehicle for iron, it has to be white in color, meeting the regulatory and operational specifications and industry standards. Dietary intake, biochemical indicators and anthropometric indices were measured at baseline, 4.5 months (0-5.6 %; p=0.96), 9 months (0.3-11.4 %; p=0.65), 13 months (21.5-27.8 %; p=0.13), and at 27 months (2.9-5.8 %; p=0.05). Iron absorption was calculated based on incorporation of isotopic iron isotopes into erythrocytes.

Conclusions: To ensure that all rice in whatever form, except brown rice and locally produced glutinous rice, are fortified with iron, such that the consumption of iron fortified rice (FIR) would contribute an additional 35% or more of the RDA of iron. Aims: To ensure that all rice in whatever form, except brown rice and locally produced glutinous rice, are fortified with iron, such that the consumption of iron fortified rice (FIR) would contribute an additional 35% or more of the RDA of iron.

Methods: The National Food Authority (NFA), being the rice regulatory and stabilization government agency which holds a monopoly of the country’s rice stock inventory, developed the systems and procedures for rice fortification on a commercial scale. Included are the adoption of the appropriate rice fortification technology, advocacy and promotional activities, distribution and marketing of FIR, food safety assurance, quality control and program monitoring. Within the NFA is a committee and a technical working group created to oversee the implementation of activities for rice fortification.

Results: The National Food Authority (NFA), being the rice regulatory and stabilization government agency which holds a monopoly of the country’s rice stock inventory, developed the systems and procedures for rice fortification on a commercial scale. Included are the adoption of the appropriate rice fortification technology, advocacy and promotional activities, distribution and marketing of FIR, food safety assurance, quality control and program monitoring. Within the NFA is a committee and a technical working group created to oversee the implementation of activities for rice fortification.

Conclusions: To ensure that all rice in whatever form, except brown rice and locally produced glutinous rice, are fortified with iron, such that the consumption of iron fortified rice (FIR) would contribute an additional 35% or more of the RDA of iron. Aims: To ensure that all rice in whatever form, except brown rice and locally produced glutinous rice, are fortified with iron, such that the consumption of iron fortified rice (FIR) would contribute an additional 35% or more of the RDA of iron.
W17  IMPACT OF A MULTIPLE-MICRONUTRIENT FORTIFIED SALT ON THE NUTRITIONAL STATUS AND COGNITION OF SCHOOLCHILDREN

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Objective: This study was conducted to test the efficacy of a multiple micronutrient fortified cooking salt added to food during cooking.

Methods: A pre- and post-test design was used to study children 5 to 18 years of age, with an experimental and a control group. The experimental group (n = 231) consisted of children from 1 residential school, and the control group (n = 149) consisted of children from 3 residential schools. The experimental group received a multiple micronutrient fortified salt containing vitamin A, vitamin B1, vitamin B2, vitamin B6, vitamin B12, folic acid, niacin, iron, iodine and zinc. The control group received iodised salt. Intervention period was 9 months. Children in the experimental and control groups were matched by socioeconomic status, age, and eating habits at baseline. All the children in the experimental and control schools were dewormed at baseline, after 4 months, and at the endpoint (after 9 months). Hemoglobin levels were measured in all the children 3 times during the study - at baseline, after 4 months (midpoint) and after 9 months (endpoint) where as the other biochemical measurements were done in a subsample of children. Children who were older than 15 years were given cognitive tests for memory and attention.

Results: There was a significant improvement in the following biochemical measurements in the experimental group when compared with the control. After 9 months of treatment, the children in the experimental group had significantly higher hemoglobin levels compared to the control (12.4 ± 1.4 g/dL vs. 11.9 ± 1.4 g/dL, p < 0.05). The prevalence of anemia decreased from 20.5% at baseline to 14.1% at endpoint (p < 0.05) and the prevalence of iron deficiency decreased from 31.3% at baseline to 19.1% at endpoint (p < 0.05). There was a significant improvement in the WRSI, FSIQ, and these scores are shown in the experimental group compared with the control group.

Conclusions: This study provides evidence that a multiple micronutrient fortified salt added to food during cooking can improve the nutritional status and cognitive function of school children.

W19  CONSUMPTION OF IRON FORTIFIED WHEAT FLOUR AND IRON DEFICIENCY AMONG WOMEN IN A CROSS-SECTIONAL SURVEY

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Background: Iron deficiency leads to increased mortality, morbidity, psychomotor disorders, and anemia. Women and preschool children have the highest prevalence of iron deficiency. The objective of this study was to determine the prevalence of iron deficiency among women in a cross-sectional survey in Oman, where wheat flour has been fortified with 10 ppm electrolytic iron and folic acid since 1997, among 19 to 25 year old non-pregnant women.

Methods: Of 412 women, 396 were interviewed and 364 agreed to participate. The average household per capita intake of iron fortified wheat flour (herein referred to as per capita) was calculated as the amount of iron fortified wheat flour consumed per month within the household divided by the number of individuals living in the household. The iron deficiency was defined as a serum ferritin < 15 μg/dL. The primary exposure was the average monthly household per capita intake of iron fortified wheat flour (herein referred to as per capita) calculated as the amount of iron fortified wheat flour consumed per month within the household divided by the number of individuals living in the household. The iron deficiency was defined as a serum ferritin < 15 μg/dL. The primary exposure was the average monthly household per capita intake of iron fortified wheat flour (herein referred to as per capita) calculated as the amount of iron fortified wheat flour consumed per month within the household divided by the number of individuals living in the household. The iron deficiency was defined as a serum ferritin < 15 μg/dL.

Results: The prevalence of iron deficiency was 31.3%, and the average household per capita intake of iron fortified wheat flour was 2.6 g/day. There was a significant positive association between the prevalence of iron deficiency and the average monthly household per capita intake of iron fortified wheat flour (β = 1.25, p = 0.01). The prevalence of iron deficiency was 18.2% in the group with per capita intake of iron fortified wheat flour > 2.5 g/day and 44.9% in the group with per capita intake of iron fortified wheat flour ≤ 2.5 g/day.

Conclusions: The prevalence of iron deficiency is 31.3% among women and 50% among preschool children in Oman. The average monthly household per capita intake of iron fortified wheat flour (herein referred to as per capita) calculated as the amount of iron fortified wheat flour consumed per month within the household divided by the number of individuals living in the household. The iron deficiency was defined as a serum ferritin < 15 μg/dL. The primary exposure was the average monthly household per capita intake of iron fortified wheat flour (herein referred to as per capita) calculated as the amount of iron fortified wheat flour consumed per month within the household divided by the number of individuals living in the household. The iron deficiency was defined as a serum ferritin < 15 μg/dL.
W21  FORTIFIED FOODS IMPROVED MICRONUTRIENT STATUS AMONG SCHOOL CHILDREN IN DISADVANTAGE AREAS OF ACEH, INDONESIA

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Background: The prevalence of micronutrient deficiencies among vulnerable groups might inflate following disaster. Foods (biscuit and noodle) fortified with 9 vitamins and 4 minerals were distributed in Aceh Province following the Tsunami in 2004 to school children, children 12-59 months and pregnant and lactating women (PLW).

Objective: To assess changes of micronutrient status (anaemic, iron, and vitamin A status) among school children receiving daily fortified biscuit for about 1-1.5 years and frequent nutrition education and better personal hygiene and sanitation behaviour among school children, children 12-59 months and PLW (n=709 at the first; and n=518 at the follow-up study). Each study involved 30 primary schools in rural area from 5 districts in the Province. The first survey was conducted in March-April 2006, and the follow-up was in July-August 2007. Between studies, dormaying tablets was distributed.

Method: A cross-sectional study was conducted among primary school children (n=709 at the first, and n=518 at the follow-up study). Each study involved 30 primary schools in rural area from 5 districts in the Province. The first survey was conducted in March-April 2006, and the follow-up was in July-August 2007. Between studies, dormaying tablets was distributed.

Findings: The prevalence of anemia and vitamin A deficiency/VAD in the follow-up study was significantly lower than those in the first study. Anemia prevalence reduced from 29.8% to 22.1% (RR=0.74, 95% CI: 0.61-0.90, p=0.004), and Hb level was increased from 11.6 to 12.7 g/H (RR=0.67, 95% CI: 0.45-0.98, p=0.03). Boys, although not statistically different, tended to have higher prevalence of anaemia and VAD compared to girls. Iron deficiency (indicated by serum ferritin<15pg/L) remained low in the first and follow-up study (8.4% and 6.1%, respectively). Prevalence of worm infestation was significantly reduced (57.7% to 35.6%). The infection was found to be negatively associated with plasma retinol concentration, but not with concentration of hemoglobin nor serum ferritin.

Conclusion: Distribution of fortified food had significantly improved the micronutrient status of school children, particularly with respect to anemia and vitamin A deficiency. The positive effect might also be contributed by lower load of worm infestation.

The study was funded by WFP Indonesia office.

W22  MICRONUTRIENT DEFICIENCIES AMONG SCHOOL CHILDREN, CHILDREN 12-59 MONTHS AND PREGNANT AND LACTATING WOMEN IN DISADVANTAGE AREAS OF ACEH, INDONESIA

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Background: The prevalence of micronutrient deficiencies among vulnerable groups might inflate following disaster. Foods (biscuit and noodle) fortified with 9 vitamins and 4 minerals were distributed in Aceh Province following the Tsunami in 2004 to school children, children 12-59 months and pregnant and lactating women (PLW).

Objective: We aimed to assess the prevalence of micronutrient deficiencies among school children, children 12-59 months and PLW after receiving fortified food for about 1-1.5 years. Additionally, we also evaluated the personal hygiene and sanitation practice and nutrition education.

Method: A cross-sectional study was conducted among school children (n=518), pregnant and lactating women (n=417) and children 12-59 months (n=190) from 30 clusters in 8 districts.

Findings: The prevalence of anaemia among children 12-59 months was 70.9%, PLW 62.1% and schoolchildren 22.1%. Among PLW, the prevalence of iron and vitamin A deficiencies were 37.3% and 10.6%. The respective figures for school children were 6.1% and 12.7% and children 12-59 months were 37.3% and 10.6%. Nutrition education from cadres or midwives was provided only once in a month, and only 70.4% of PLW and 41.9% of mothers of children 12-59 months. School children (92.3%) claimed to receive nutrition education from their teachers either on weekly or monthly basis. Higher proportions of school children used drinking water from protected water sources (92.3%) and claimed to receive nutrition education from their teachers either on weekly or monthly basis. Higher proportions of school children used drinking water from protected water sources (92.3%) and claimed to receive nutrition education from their teachers either on weekly or monthly basis.

Conclusion: The prevalence of micronutrient deficiencies was relatively high among PWL and children 12-9 months despite distribution of fortified foods. Receiving more regular and frequent nutrition education and better personal hygiene and sanitation behaviour among school children may contribute to better micronutrient status compared to the other vulnerable groups.

The study was funded by WFP Indonesia office.

W23  COMBINED MICRONUTRIENTS IN JUICE DRINK: EFFECTS ON IRON AND ZINC STATUS OF SCHOOL CHILDREN

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Background: Despite local investments to control iron deficiency anemia (IDA), the IDA prevalence rate in recent survey is still high (37.4%) among children, 6 to 9 years old. IDA coupled with other micronutrient deficiencies and underweight results in poor physical and mental performance among children. Fortifying commonly consumed foods with multi-micronutrients could be an innovative strategy to reduce IDA prevalence.

Objective: To determine the effects of combined micronutrients in a beverage in improving iron and zinc status of schoolchildren.

Methods: Children enrolled in Pinaglabanan Elem. School were grouped into anemic (100) and underweight (100) children. Random allocation by groups was done. Anemic children, Group 1, were fortified-fed (50) and Group 2, unfortified-fed (50). Similarly, underweight children, Group 3, fortified-fed (50) and Group 4, unfortified-fed (50). The juice was fortified with iron, vitamin A, zinc, vitamin C, and folic acid. The fortified beverage contained only vitamin C. Children received 200 ml packs of beverage per day for 100 feeding days under a supervised regime. Empty packs were retrieved from the children on-site. Anthropometric and biochemical data were collected at baseline and after the 100 feeding days. Hemoglobin (Hb), plasma ferritin (PF), plasma zinc (PZ) were measured using standard Methods. Food intake was collected using the 24-hour food recall.

Results: Among anemic children, Hb level in the fortified group was significantly higher (12.6±g/L) than in the unfortified group (12.0±g/L). The prevalence of anemia was significantly reduced from 100% to 13.0% (fortified-fed) and 19.3% (unfortified-fed). Among underweight children, there was no significant difference in mean Hb level between groups but the mean increase in the "fortified group" was significantly higher (2.1 g/L) than in the "unfortified group" (1.4 g/L). Both the anemic and underweight children had increased PF levels as both the fortified and unfortified groups but the mean increase in underweight fortified group was higher (25.2 µg/L) than in the unfortified group (16.5 µg/L). Among the fortified-fed anemic children, IDA was from 100% to 38%, iron deficiency, 20% to 2%, and zinc deficiency, 4% to 0% among the anemic and underweight children, IDA, 100% to 40%, iron deficiency 21% to 0%, zinc deficiency, 4% to 0%. Among underweight anemic children, IDA, 100% to 21.1%, iron deficiency, 21% to 5%, and zinc deficiency, 5% to 10%. Adequacy of intake of iron, vitamin A and C and protein did not show significant correlation with Hb and PF levels.

Conclusion: The combined micronutrients in the juice were effective in improving iron and physical growth of schoolchildren. Recommendation: It is recommended that nutrients with complementary roles should be added in beverages to obtain significant results especially if such is positioned to address deficiencies among schoolchildren.

W24  IRON FORTIFICATION OF NOODLES AND ITS SHELF LIFE

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Introduction: Fortification is defined as "the addition of one or more essential nutrients to a food, whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more essential nutrients in the population (Codex, 1999). One of every four people in the world suffer from micronutrient deficiencies. Aim of the study: To test whether noodles can be used as an appropriate food vehicle for iron fortification. Scope of the study: Value addition of ready to eat popular foods will help to mitigate the problem of iron deficiency in the long run. Materials and methods: Two different varieties of whole wheat flour (atta) noodles were made, out of which one was made with plain atta flour (WF1) and other with incorporation of EDTA ferric monosodium salt (WF2c). Moisture, ash, acidity, total solids in gruel, iron content and protein content were analysed as per Bureau of Indian Standard's (BIS) specification, along with sensory analysis. Results: WF2c which had the highest level of fortification scored the best with 4.13±0.30 on a five-point scale for overall acceptability. The fortified sample had a pair chocolate brown colour and this increased the appeal of the product. There was found to be gradual reduction in the taste score for both fortified and unfortified formulations on storage. No significant difference was identified in the flavour of WF1 (0.3) and WF2c (0.1) at 5% level. The cooked noodles which was kept for evaluation had the right texture on all days except on day 20, on which it was mushy. The scores of both the noodles were above four on a five-point scale for overall acceptability all through the storage period. The moisture content of both formulations were within the Bureau of Indian Standard's (BIS) specification of 14%±1%. The ash content of WF1 (1.8±0.26) and WF2c (2.6±0.19) was the same all through the storage period. The protein content of WF2c (16.5g%) was higher than the protein content of WF1 (14.5g%). Its significant difference was observed in the total solids in gruel (10 days vs 60 days) values of both WF1 (10±0.51) and WF2c (10±0.0). The unfortified sample had a total acidity of 4.6 while the fortified sample (WF2c) had a value of 4.1 against the BIS specification of 4.01±1.00%. The iron content of WF1 was 4.9mg/100g whereas WF2c had nearly five times higher iron content (23mg/100g).

Conclusion: Noodles is an ideal vehicle for iron fortification.
**W25**  
**FOOD BASED AND CHEMICAL BASED VALUE ADDITION IN PIZZA – A COMPARATIVE STUDY**  
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**Introduction:** Iron deficiency and resultant anaemia are recognized public health problems in India. Food fortification is a major cost effective and sustainable solution. Fortification in bakery products is an emerging area of interest.  
**Aims:** To assess the possibility of value addition in pizza base at different levels with selected food and chemical fortificants. Scope of the study: Fortification of fast foods like pizza may help in alleviating the iron deficiency anaemia in adolescents. Methodology: Mint and manjushakali (Solanum nigrum) were chosen as food fortificants and NaFeEDTA as a chemical fortificant. Totally nine food fortified basies (three variations (FTA, FFB & FTC) with three levels of incorporation in each variation) and three chemically fortified (CF1, CF2, & CF3) basies were prepared. Sensory and quality analysis as per Bureau of Indian Standards were done for the pizza and pizza base respectively and compared with control.  
**Results:** All food fortified pizza except for FFB2 and FBB3 scored 4.5 and above for their colour and appearance. The highest score of 4.6±0.6 was obtained for flavour by FBB2. The third level of all three variations got the lowest score for texture. The highest score for taste was obtained by FBB1 (4.8±0.41). In all nine food fortified samples, the overall acceptability was higher than 4.8. Chemical fortified pizzas’ scores were similar to that of food fortified pizzas’ scores but for the texture of CF3 (4.5 ± 0.4). All the fortified samples’ total solid content, pH was above the standard value of 60% and 5 ± 6 respectively. The crude fibre and acid insoluble ash were found to be in all samples. An increase in iron content (both food fortified and chemical fortified pizza bases) ranging from 4.5 to 9.87 mg/kg was observed. The pizza bases were found to be fresh up to 72 hours only.  
**Conclusion:** Pizza bases can be iron fortified to alleviate iron deficiency anaemia.

**W26**  
**FLOUR FORTIFICATION IN EAST ASIA: POTENTIAL, STATUS AND ISSUES**  
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**Background:** There is strong evidence from a number of countries that flour fortification with folic acid dramatically reduces rates of neural tube defects. In the United States it has also been cited as the reason for declines in mortality from stroke. The degree of reductions in iron deficiency and anaemia reported as a result of flour fortification with iron appear to depend on the type of iron fortificant used and baseline anaemia/iron deficiency levels. Efficacy studies suggest considerable potential for additional improvements in addressing iron deficiency through flour fortification. Despite the fact that wheat flour consumption in East Asia is lower than in regions such as North America or the Middle East, flour fortification is increasingly being adopted as an important intervention in the region, usually within a package of interventions to address micronutrient deficiencies. The presentation will explore the potential of what can be achieved with flour fortification in this region, the status of current programmes, some of the issues arising and the role of the Flour Fortification Initiative (FFI), a global network of public, private and civic organisations.  
**Discussion:** Wheat flour consumption in the East Asia region has been rising, in line with economic development and urbanization. Convergence foods, such as instant noodles, are an important wheat flour product consumed in this region and are commonly eaten by the communities at highest risk of vitamin and mineral deficiencies. Two countries in the region have already adopted mandatory flour fortification and several others are actively considering the mandatory option. In some countries flour mills are among the strongest proponents of mandatory fortification while the nutrition community are not necessarily among the groups raising initial concerns. Rising wheat prices have both aided and hindered efforts towards fortification; on the one hand the price can be made that it is essential to maintain, and improve, the nutritional value of staple foods to protect the most vulnerable, while on the other hand rice consumption is being actively promoted over wheat flour in some countries where rice is domestically grown. New global recommendations on fortificant fortification are soon to be released, which have the potential to significantly improve the effectiveness of programmes adopted. The role and composition of FFI partnership varies from country to country but the principle of a network is proving effective in bringing necessary stakeholders and advocates around the same table.

**W27**  
**ACHIEVEMENTS AND CHALLENGES OF THE FLOUR FORTIFICATION PROGRAM IN GEORGIA**  
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**ACTS Georgia, Tbilisi, Georgia**  
**Institute for Strategic Research, Tbilisi, Georgia**  
**The National Wheat Flour Fortification Program Aims at reduction of micronutrient deficiency among the population of Georgia by 20% through consumption of wheat flour fortified with iron and folic acid. The project is financially supported by Global Alliance for Improved Nutrition (GAIN) and will be executed by the NGOs – ACTS Georgia and Institute of Strategic Research (IS). The process is led by the Alliance of Improved Nutrition for Georgia representing governmental-private-civic partnership. The project has four key areas, including production, legislation, quality control and assurance, and communication and social marketing. Over a three year project period, 18 large and medium sized flour mills will be selected and upgraded with microfeeders and premix (fortificant). Millers are receiving comprehensive training in production as well as quality control and assurance. Within the project time frame, 50% of wheat in Georgia will be fortified. Activities towards a mandatory wheat flour fortification law will be conducted. A quality assurance and control protocol system is being developed and implemented. Communication and social marketing campaigns are organized to promote consumer awareness and demand for fortified wheat flour.**

**W28**  
**STABILITY OF MULTI-MICRONUTRIENT-FORTIFIED JUICE DRINK**  
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**Background:** To assess the possibility of value addition in pizza base at different levels with selected food and chemical fortificants. Scope of the study: Fortification of fast foods like pizza may help in alleviating the iron deficiency anaemia in adolescents. Methodology: Mint and manjushakali (Solanum nigrum) were chosen as food fortificants and NaFeEDTA as a chemical fortificant. Totally nine food fortified basies (three variations (FTA, FFB & FTC) with three levels of incorporation in each variation) and three chemically fortified (CF1, CF2, & CF3) basies were prepared. Sensory and quality analysis as per Bureau of Indian Standards were done for the pizza and pizza base respectively and compared with control.  
**Results:** All food fortified pizza except for FFB2 and FBB3 scored 4.5 and above for their colour and appearance. The highest score of 4.6±0.6 was obtained for flavour by FBB2. The third level of all three variations got the lowest score for texture. The highest score for taste was obtained by FBB1 (4.8±0.41). In all nine food fortified samples, the overall acceptability was higher than 4.8. Chemical fortified pizzas’ scores were similar to that of food fortified pizzas’ scores but for the texture of CF3 (4.5 ± 0.4). All the fortified samples’ total solid content, pH was above the standard value of 60% and 5 ± 6 respectively. The crude fibre and acid insoluble ash were found to be in all samples. An increase in iron content (both food fortified and chemical fortified pizza bases) ranging from 4.5 to 9.87 mg/kg was observed. The pizza bases were found to be fresh up to 72 hours only.  
**Conclusion:** Pizza bases can be iron fortified to alleviate iron deficiency anaemia.
W29  PROMOTING REGIONAL LABORATORY CAPACITY FOR FORTIFIED FOODS IN EAST CENTRAL AND SOUTHERN AFRICA

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Background: The East Central And Southern Africa (ECOSA) region is made up of countries that share similar rates of micronutrient deficiencies. In addressing the issue, a number of initiatives have been initiated in order to manage the situation. Fortification of staples with vitamins and minerals is one of such programs, which has gained popularity at a regional level since 2004. In supporting this fortification work, laboratories in the region formed a network of analytical laboratories to enhance capacity for laboratories for training, updating and assessing proficiency of testing for micronutrients in fortified foods.

Aims: The aim of the program is provide reliable micronutrient testing facilities to support national food control activities related to fortified foods produced in country or imported into member states.

Methods: Training sessions have taken place in the region specifically targeting fortified salt, sugar, oil and maize flour. Laboratories have been supported in terms of small equipment and reagents in order to master the assays of vitamin A, iron and iodine. Relatively low cost Methods, both qualitative and quantitative, are promoted to ensure sustainability in resource poor laboratories. The current program involves five countries: Malawi, Zambia, Kenya, Tanzania and Uganda. To enhance capacity, a Proficiency Testing Scheme was established, among laboratories in the region. Samples of fortified foods are prepared at a coordinating laboratory and sent out to national laboratories for testing. Results are submitted to the coordinating laboratory for review and statistical analysis. A review meeting is held after each round.

Results: Three rounds of the testing scheme will have been conducted by the end of 2008. Results from the laboratories have shown improved quality of results in the subsequent rounds. Reported values have been found to be close to the expected concentrations. The assessment is based on 2-scores and the assigned values are based on the results submitted by the laboratories. Most laboratories have registered 2-scores below 1 indicating satisfactory performance. Participation in this exercise motivates and helps laboratories to improve their accuracy and so provide their national programs with results that are reliable.

Conclusions: Results show that with adequate support, laboratories in the region are able to test iodine in salt, vitamin A in flour, sugar and oil, and iron in maize, using relatively low cost Methods with results that compare well with expensive and more laborious assays.

W30  FOOD FORTIFICATION UNDER A REGIONAL APPROACH – THE EAST, CENTRAL AND SOUTHERN AFRICAN HEALTH COMMUNITY MODEL

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Background: The ECOS Health Ministers Conference recognized the potential of food fortification as a public health intervention to prevent, reduce and control micronutrient deficiencies in the ECOSA region whose levels are unacceptable high. The conference urged the Secretariat to fast-track the implementation of food fortification in member countries through adequate policy and legislation, advocacy and promotion, and food control and monitoring. Consequently, ECOSA Secretariat initiated a Regional Food Fortification Programme.

Objectives: To fortify flour with vitamin A, iron, zinc, and six vitamins of the complex B, sugar with vitamin A, and edible oil with vitamin A, and ensure full compliance of salt with iodine.

Method: Centralized building was done through Regional Workshops on the food vehicles to deliver the above micronutrients and on the key elements that required strengthening. Four technical working groups were constituted: (i) Regulations, Standards and Food Control; (ii) Laboratory Strengthening and Network; (iii) Technical and Trade Support; and (iv) Coordination, Resource Mobilization and Advocacy. The groups developed and implemented action plans, which were presented and reviewed in three regional workshops. All groups have implemented their action plans. Training and actions have been carried out at the national level.

Results: Designing and establishing a series of practical, implementation-focused guidelines in form of standards and food control manuals to assist governments facilitate food fortification; training of laboratory analysts and establishment of the ECOSA Laboratory Proficiency Testing (EPT). Exercise among the countries, delegation of food processing industries with the capacity to fortify in the region; development of advocacy tools including a website and mobilization of technical and financial resources. All ECOSA countries have started some initiatives on food fortification.

Conclusion: A regional approach reduces duplication of effort, harnesses available resources in the region in the development of standardized implementation and monitoring tools and guidelines that can easily be adopted and be supported by promoting networking with the food industry. The East, Central and Southern African Health Community is an inter-governmental organization established in 1974 to foster cooperation in health in the region. It has ten active members namely Kenya, Uganda, Tanzania, Malawi, Zambia, Zimbabwe, Lesotho, Swaziland, Mauritius and Seychelles. Its mandate is to "promote and encourage efficiency and relevancy in the provision of health services in the region.

W31  MONITORING WORLDWIDE TRENDS IN WHEAT-FOUR FORTIFICATION WITH FOLIC ACID AND IRON

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Background: Fortification of wheat flour is an effective, simple, and inexpensive strategy for supplying folic acid, iron, and other micronutrients to large segments of the world population. Furthermore, the consumption of wheat flour is greater than that of any other cereal grain. The Food Fortification Initiative’s global database on national fortification practices and policies related to flour processed in roller mills worldwide provides the opportunity for monitoring the coverage of flour fortification programs for the assessment of baseline coverage, tracking of changes with time, benchmarking, interpreting results of impact assessment, and advocacy.

Aims: To assess the global change from 2004 to 2007 in (1) the percentage of wheat flour being fortified with folic acid and iron, (2) the number of persons overall and women in particular with access to fortified wheat flour, and (3) the total number of newborns whose mothers had access to fortified wheat flour during pregnancy.

Methods: We calculated the percentage of wheat flour that is fortified using the FFLS surveillance system database. This percentage equaled the amount of fortified flour divided by the total amount of flour used in each country. The percentage of persons in each country with access to fortified wheat flour was assumed to be equal to the percentage of wheat flour that is fortified in that country. Population sizes were obtained from the U.S. Central Intelligence Agency. Country-level birth rates were obtained from the United Nations Children’s Fund (UNICEF). These values were multiplied by the percentage of fortified flour to calculate the total number of persons and women with access to fortified flour and the number of newborns whose mothers had access to fortified flour during pregnancy.

Results: The worldwide percentage of fortified wheat flour increased from 18% in 2004 to 27% in 2007. The estimated number of persons with access to fortified flour increased by approximately 540 million, and the annual number of newborns whose mothers had access to fortified flour during pregnancy increased by approximately 14 million.

Conclusions: The total number of persons and women who had access to fortified wheat flour and the number of newborns whose mothers had access to fortified flour increased from 2004 to 2007; however, the majority of the world population still lacks access to fortified flour and to the folic acid, iron and other micronutrients this flour provides. Programs should continue to expand coverage of wheat flour fortification as one of a number of strategies to improve micronutrient consumption. Monitoring of flour fortification programs and progress should remain a priority.

W32  VITAMIN A AND IRON INTAKE AMONG PRESCHOOL-AGE CHILDREN WITH OR WITHOUT FORTIFICATION OF PROCESSED FOODS AND FORTIFIED STAPLES

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Background: Over the years, NVDA and DA have affected women and children in significant proportions. The Philippine government has promoted food-based approaches to improve the nutritional status of the population, specifically by advocating and making mandatory the fortification of staples (RA 8976) and processed foods (the Sangkap Pinoy Seal (SPS) Program in 1999. The analysis was carried out to examine the progress of the food fortification campaign, and the expected impact on nutrient intakes when RA 8976 is implemented in full force with the partnership between government and private sector.

Aims: (1) To compare the current vitamin A and iron intakes among preschool-age children with the vitamin A and iron intakes of the same children, assuming non-fortification of food products with iron and/or vitamin A, and (2) to compare the current vitamin A intake among preschool children with those of the same children, assuming fortification of food products with iron and/or vitamin A, and vitamin A and iron intakes without fortification were conducted using the energy and nutrient values from equivalent unfortified foods in the 1997 Philippine FCI to replace vitamin A and iron values of SPS food products in the actual intake. Then again, simulation of intake with fortification of staple foods was done using vitamin A values of fortified flour, sugar, and cooking oil, assumed at a conservative 50% compliance of the fortification level stipulated by the Law, Descriptive statistics as well as univariate analysis were utilized in coming up with the results of the study.

Results: Assuming non-fortification of SPS products with vitamin A and/or iron, the intake of vitamin A would be reduced by 36% of current intake and iron by 7%. On the other hand, fortification of flour, sugar, and cooking oil with vitamin A assuming a conservative 50% compliance of the fortification level stipulated by the Law, Descriptive statistics as well as univariate analysis were utilized in coming up with the results of the study.

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Conclusions: The full implementation of the Food Fortification Law will contribute towards significant improvement of vitamin A intake. But a thorough review of the guidelines including identifying basic commodities for mandatory fortification is encouraged to optimize the impact.
Background: The policy for food fortification to control micronutrient malnutrition stared on 1995 with the enactment of Regulad Act 8433 mandating iodination of salt for human and animal consumption so called ASIN Law. On Nov. 7, 2004, the then President Joseph Estrada signed into law RA 8974 that requires mandatory fortification of wheat flour with vitamin A and iron, cooking oil with vitamin A, refined sugar with vitamin A and rice with iron by Nov. 7, 2004. The Bureau of Food and Drugs (BFAD) was tasked to implement mandatory fortification Mandating fortification of staples was necessitated due to the growing problem of iodine deficiency disorder (IDD), vitamin A deficiency (VAD) and iron deficiency anemia (IDA) based on the 1993 and 1998 National Nutrition Survey (NNS). In the 2003 NNS, with increased availability of iodized salt, there was an improvement in IDD status. However, VAD and IDA continue to be major nutritional problems.

Aim: To identify program challenges, methods, results and lessons learned related to regulating mandatory fortification of 5 staples, Program Challenges: The 5 mandated staples for fortification have vastly different industry characteristics that require different approaches particularly in regulating to ensure compliance. Prior to the ASIN Law, no government agency has regulated the salt industry making it difficult to enforcing regulations which some has considered as backyard agricultural production. Wheat flour, cooking oil, sugar and rice could be considered as “political” commodities with strong industry groups with political support. Cooking oil, sugar and rice are usually sold in unlabeled, fortified in increased availability. By November 7, 2004 some wheat flour and cooking oil are fortified but their monitoring was limited. In 2006 and 2007, BFAD conducted a more intensified monitoring of wheat flour both local and imported. By 2007, all local wheat flour supplied most of the flour is fortified with vitamin A and iron. However, quality of fortification needs improvement. Though limited monitoring of labeled cooking oil shows majority are fortified, this will be intensified using a field test kit in 2008. Limited premix makes rice and sugar available in only a few areas. Lesson Learned: Prior to mandating fortification of staples, it is important to study industry characteristics to determine if such can be regulated and the requirements needed to ensure compliance can be provided.

Results Initiative for the flour market resulted in two manufacturers applying for certification system for composite flours using little outside consulting support. Based on the 1993 and 1998 National Nutrition Survey (NNS). In the 2003 NNS, with increased availability of iodized salt, there was an improvement in IDD status. However, VAD and IDA continue to be major nutritional problems.

Conclusions: The success of the KNFFA's experience offers lessons to other fortification alliances wishing to overcome the hurdles showing progress on large scale fortification efforts. Specifically, the Rapid Results Initiatives show how fortification alliances can 1) restructure their strategic plans in ways that make it easier to obtaining the trust and mutual confidence between private and public sector needed for long term success, 2) use short-term results-based projects as a tool for generating political and private sector buy-in and 3) create an environment which facilitates rapid capacity building among the technical staff whose skills are crucial to the success of fortification programs.

LESSONS FROM 50 YEAR OF IRON FORTIFICATION – IMPACT OF DIET COMPOSITION AND IRON FORTIFICATION WITHDRAWAL ON IRON DEFICIENCY

W35

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When it comes to iron balance and absorption the primary dietary aspects to consider are; iron bioavailability, and the amount of iron in the diet. When it comes to the scientific evidence for the comparative-effect from each of these measures in improving iron balance in man, there are still questions.

In 1994 Swedish millers decided to withdraw the voluntary iron fortification of all white wheat flour which had been carried out for 50 years. This unique situation made it possible to study the effect of iron fortification, and the effects of withdrawal of iron fortification among vulnerable groups in the population.

To study the effects of the withdrawal of iron fortification, two cross-sectional studies were performed in Göteborg, Sweden. One in 1994 were a random sample of approximately 600 fifteen- to sixteen-year-old girls was examined, and the other in 1999 another sample of girls of the same age was examined. Adolescents menstruating girls were chosen as a suitable model since they have high iron requirements as well as menstrual losses.

The primary outcome assessed before, and six years after the Swedish iron fortification withdrawal, was iron status. Also series of possible confounding factors were examined and eliminated such as differences in diet, use of contraceptive pills, physical activity, intake of iron supplements etc.

The result showed that, in 1994, fortification iron from wheat flour represented almost 40% of the dietary iron intake. Six years after the withdrawal, the marked decrease in total iron intake led to a lower amount of available iron. During the same time, the prevalence of iron deficiency (serum ferritin <14 µg/L) increased from 39 before the withdrawal to 56% after the withdrawal, an increase of 28%. Considering differences in the diet, and composition of separate meals there was a slight decrease in dietary iron bioavailability.

Taken together, the combined action of a decreased intake of fortification iron, and a dietary composition giving a lower dietary iron bioavailability, gave six years after iron fortification, an situation of decreased iron balance. This was also evident from the increased iron deficiency prevalence.

W34

GETTING THINGS DONE: HOW THE RAPID RESULTS APPROACH ENHANCED PUBLIC-PRIVATE COOPERATION ON A LARGE-SCALE FOOD FORTIFICATION EFFORT IN KENYA

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Background: High levels of cooperation between the public sector and private sector actors are needed to ensure large-scale voluntary food fortification programs are effective and sustainable. Precisely because obtaining this cooperation is often extremely difficult, there are few such fortification programs in existence in developing countries. Food companies, health officials are often so overwhelmed with more visible (and hence more urgent) health issues that they are unable to dedicate the time needed to guide policy changes. Similarly, government officials are often so overwhelmed with more visible (and hence more urgent) public health issues that they are unable to dedicate the time needed to guide policy changes. For instance, in the area of food fortification.

Results Initiative for the flour market resulted in two manufacturers applying for certification system for composite flours using little outside consulting support. Based on the 1993 and 1998 National Nutrition Survey (NNS). In the 2003 NNS, with increased availability of iodized salt, there was an improvement in IDD status. However, VAD and IDA continue to be major nutritional problems.

Conclusions: The success of the KNFFA's experience offers lessons to other fortification alliances wishing to overcome the hurdles showing progress on large scale fortification efforts. Specifically, the Rapid Results Initiatives show how fortification alliances can 1) restructure their strategic plans in ways that make it easier to obtaining the trust and mutual confidence between private and public sector needed for long term success, 2) use short-term results-based projects as a tool for generating political and private sector buy-in and 3) create an environment which facilitates rapid capacity building among the technical staff whose skills are crucial to the success of fortification programs.

MULTIPLE MICRONUTRIENT FORTIFIED BISCUITS DECREASED PREVALENCE OF ANAEMIA, AND IMPROVED MICRONUTRIENT STATUS AND EFFECTIVENESS OF DEWORMING IN RURAL VIETNAMESE SCHOOL CHILDREN

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Background: Concurrent micronutrient deficiencies are prevalent among Vietnamese school children. A school-based program providing food fortified with multiple micronutrients could be cost-effective and sustainable strategy to improve health and functions of school children. However, the efficacy of such an intervention may be compromised by a high prevalence of parasitic infestation.

Aims: To evaluate the efficacy of school-based intervention using multi-micronutrient fortified biscuits, with or without deworming on anaemia and micronutrient status in rural Vietnamese schoolchildren.

Methods: In a randomized, 2x2 factorial, double-blind, placebo-controlled trial, 510 schoolchildren, aged 6-8 years, living in rural North Vietnam received albendazole (400 mg) at baseline and/or multi-micronutrient fortified biscuits and/or placebo. Micronutrients in the biscuits included iron (6mg), zinc (5.6mg), iodine (35µg), vitamin A (300µg). Biscuits were given five days a week for four months.

Results: Parascist infestation was highly prevalent, with >80% of the children being infected with either Trichuris or Ascaris. The majority of the children had a low intensity of infection. Multi-micronutrient fortification significantly improved the concentrations of hemoglobin (+1.67 g/dL, 95% CI: 0.78, 2.56), plasma ferritin (+7.5 µg/L, 95% CI: 2.8, 12.6), body iron (+0.56 mg/kg body weight, 95% CI: 0.02, 0.84), plasma zinc (+0.61 µmol/L, 95% CI: 0.26, 0.95), plasma retinol (+0.041 µmol/L, 95% CI: 0.001, 0.08), and urinary iodine (+22.9 µmol/L, 95% CI: 7.5, 37.3). Fortification reduced the risk of anemia, and deficiencies of zinc and iodine by >40%. Parasitic infestation had no significant effect on fortification efficacy, but fortification significantly enhanced deworming efficacy, with the lowest re-infection rates in children receiving both micronutrients and albendazole.

Conclusions: Multi-micronutrient fortification of biscuits is an effective strategy to improve micronutrient status of rural Vietnamese schoolchildren, and a high prevalence of parasite infestation (of low intensity) does not significantly affect effectiveness. Moreover, deworming effectiveness was improved by the consumption of multi-micronutrient fortified biscuits, indicating that these combined health interventions are beneficial.

W36
**W37**

**ASSESSMENT OF KNOWLEDGE ATTITUDES AND PRACTICES OF BAKERS IN THE USE OF IRON-FORTIFIED FLOUR IN THE NORTHEAST OF CASABLANCA IN MOROCCO**

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**Background:** In Morocco, 15,000 new cases of iron deficiency anaemia are annually detected. In 2005, more than 3,100 patients were recorded in regions of Big Casablanca and Rabat/Salé/Zemmour Zai. This alarming statistics has led to joint efforts between the National Fortification Alliance (NFA) and its partners to develop strategies to fight micronutrient deficiency challenges. Thus, iron-fortified flour is now available in the Moroccan markets.

**Objective:** To evaluate knowledge, attitudes, and practices (KAP) survey in the use of iron-fortified flour by bakers in north-east Casablanca, and to provide education and information sessions to the bakers after the KAP survey.

**Methods:** The use of iron-fortified flour by bakers in north-east Casablanca has been evaluated in 100 bakers. Questionnaires were prepared to assess: (i) their level of knowledge on iron deficiency anaemia, food fortification processes in general, flour fortification with iron in particular, (ii) the main source of information on fortified foods, and (iii) their contribution in 100 bakers. Questionnaires were prepared to assess: (i) their level of knowledge on iron deficiency anaemia, food fortification processes in general, flour fortification with iron in particular, (ii) their main source of information on fortified foods, and (iii) their contribution to support the national food fortification programme. The survey was conducted twice in two successive years, 2007 and 2008, and was carried out by graduate nutrition students from Hassan II Mohammed University in collaboration with NFA. The education courses were provided by the students.

**Results:** (1) 86% of bakers accepted to be interviewed in both years. (2) 34.5% of the bakers use fortified flour in 2008 against 21% in 2007. (3) The main reasons of the non-use of fortified flour are similar to those identified in 2007, and are mostly related to lack of information and education. They can be summarized as follows:

- **Price:** Majority of bakers do think that fortified flour would be more expensive.
- **Bread aspect:** Colour, taste, as well as the **increased risk of customer refusal**
- **Non-availability of fortified flour**

After the information / education sessions, 80% of the bakers who do not use or do not know about the fortified flour were ready to contribute to NFA efforts by using the fortified flour, by disseminating the information and by sensitizing customers and colleagues.

**Conclusions:** Our action based on information / education towards the bakers constitutes a real footbridge between producers and consumers. The bakers play an important role in this national effort to fight against iron deficiency anaemia as more than 60% of Moroccan population buy bread from the bakers.

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**W38**

**SOCIAL MARKETING AND COMMUNICATIONS: AN ESSENTIAL ELEMENT TO A SUCCESSFUL FORTIFICATION PROGRAMME**

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**Background:** Anaemia due to iron deficiency and Vitamin A deficiency are the most widespread micronutrient deficiencies in Ghana. While over 75% of preschool children are deficient in these two micronutrients, about 65% of pregnant women and 41% of women of child-bearing age are anaemic, largely as a result of iron deficiency and anaemia.

**Aim:** A social marketing campaign being implemented as a key component of the GAIN-supported National Food Fortification Programme in collaboration with UNICEF with the aim of creating awareness and providing information on the benefits of controlling these deficiencies through the consumption of fortified and vegetable oils produced and food made from fortified vegetable oils as part of a nutritionally adequate diet.

**Methods:** The start of wheat flour and vegetable oil fortification in Ghana was followed by a social marketing and communications campaign. Consumer research into development of messages and materials.

**Results:** Social marketing campaign was implemented as a key component of the GAIN-supported National Food Fortification Programme in collaboration with UNICEF with the aim of creating awareness and providing information on the benefits of controlling these deficiencies through the consumption of fortified wheat flour products and food made from fortified vegetable oils as part of a nutritionally adequate diet.

**Conclusions:** As comprehensive and effective social marketing is key to successful implementation of a fortification programme, the campaign is expected to contribute to increasing awareness about the micronutrient deficiencies and the benefits of consuming fortified foods as a means of controlling these deficiencies. The campaign is also expected to improve consumption of fortified foods. Its implementation is however a challenge due to the high cost of mass media activities. Pre-requisite should be given to community level communication activities for wider spread of messages.

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**W39**

**PARTNERSHIP FOR ACCELERATING VITAMIN A FORTIFICATION OF COOKING OIL IN FRANCOPHONE WEST AFRICA: “FAIRE TACHE D’HUILE EN AFRIQUE DE L’OUEST”**

F. Jutet, 1 A. Madou, 1 R. Fayet, 1


This is an innovative Public Private Partnership (PPP) to accelerate the provision of vegetable oil with Vitamin A to eight West African countries that have some of the highest under-five mortality rates in the world. In Africa, this work represents a unique example of a multi-country project in food fortification with the commitment of multiple private and public sector institutional partners. The project seeks to reduce child morbidity and mortality linked to vitamin A and will empower 15 vegetable oil producing-industries to adopt fortification. The Assembly of Health Ministers of the Economic Community of West African States passed a resolution for mandatory fortification in 2006. Key stakeholders in West Africa organized private-public sector dialogues in 2002 and 2007 which resulted in strong recommendations for advancing food fortification and ensured the creation of national food fortification alliances throughout West Africa. Memoranda of understanding were signed among partners. Major funding partners of this regional initiative include: GAIN, USAID, NIH, NIEPA, Government of Taiwan, WHO with technical support from WHO, UEMOA, AIFO, SAFIV, BASF and DSM. Preliminary activities were led by NIEPA and NIH, identifying potential food vehicles, with follow up direct funding from GAIN supporting fortification programs in Mali and Cote d’Ivoire.

This multi-partner program has achieved several important strategic milestones since its inception in 2007. These include the endorsement of regional as well as national policies, industrial assessment/capacity building activities, procurement of vitamin A premix, expanding partnership networks, securing leveraged funding, strengthening regional institutions, establishing harmonized regional standards, adopting a logo, creating consumer awareness, launching fortified foods and promoting advocacy to sustain food fortification. The vegetable oil industries in Benin, Cote d’Ivoire and Mali are fortifying their vegetable oil with equipment installation almost completed for industries in Benin and advancing in Niger, Senegal and Senegal. Vitamin A premix will be procured for most industries by the end of 2008. As a follow up to the success of the vegetable oil project NIEPA-UEMOA and GAIN proceeded to declare the “Fortify West Africa” initiative to include cereal flour fortification in the region in September 2007. Currently there are over 10 private-public sector institutions actively involved in the project. At the end of the project in 2010, 70% of the population will receive almost 30% of their RDA of Vitamin A from fortified vegetable oil. The total population of the UEMOA Region is 85 million, of whom 15.6 million are children under five. The estimated impact of vitamin A fortified oil in West Africa will be to save the lives of over 156,000 children under five years in the region annually.

From the input and process indicators in the implementation plan, most targets were met for 2007 and these include equipment installation in most industries at least four stakeholders meetings, held to discuss, review and adjust standards with logo and launch fortified oil. Additional industries joining AIFO-UEMOA and industries started an oil fortification in Burkina Faso and Mali. NIEPA establishment underway in Cote d’Ivoire and moves already in place in Benin. Additionally, in Benin, the vitamin A premix was procured for industries in Burkina Faso and an estimated planned 100000 (7 million Oil) of premix procurement underway for Burkina Faso and Senegal. There is broad international as well as local press coverage through fortification events with strategic social marketing. As evidence, the momentum is very strong in the region to sustain food fortification.

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**W40**

**SAFETY OF MAIZE FLOUR FORTIFICATION WITH IRON AS NAFEDETA**

P. Adriani, 1 S. Goazutupa, 1 F. Apah, 2 D. Mavukw, 1 R. Wijayaditya, 1

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**Background:** Iron from NafeDETA is highly bioavailable, and NafeDETA is recommended for fortification of high-phytate flours. Individuals with α(+)-thalassaemia may absorb iron more efficiently, which may result in iron loading. Because of chelating properties, EDTA might theoretically also reduce the absorption of other nutritionally important mineral elements.

**Objectives:** We assessed the effect on iron status of consuming non-fortified whole maize flour in children with and without α-thalassaemia, and the effect of this intervention on the status of five nutritionally important mineral elements.

**Methods:** Children aged 3-8 years (n=156) were randomized to daily consumption for 5 months of porridge prepared from whole maize flour, which was either unfortified, fortified with NafeDETA or electrolytic iron (56 mg iron/kg flour), or fortified with NafeDETA (28 mg iron/kg flour). The effect of the intervention was assessed in 48 children whose α(+)–thalassaemia genotype was determined. Plasma levels of ferritin, zinc, copper, calcium and magnesium, as well as haemoglobin concentrations, were assessed at baseline and after five months of porridge consumption in all 156 children.

**Results:** There was no evidence that the effect of the intervention on iron status was influenced by α(-)–thalassaemia genotype, or that plasma levels of zinc, copper, calcium, magnesium or manganese depended on the type of iron, or on the level of NafeDETA consumed when expressed per kg body weight.

**Conclusion:** We found no evidence that NafeDETA in the levels provided is unsafe for individuals with α(+)–thalassaemia, or that it affects the status for the mineral elements other than iron.
W41	TWELVE YEARS OF SURVEILLANCE OF SALT AND SUGAR FORTIFICATION PROGRAMS THROUGH SENTINEL SCHOOLS: COVERAGE AND QUALITY OF THE FORTIFIED FOODS IN GUATEMALA

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Background: UNICEF, INCAP and the National Commission of Food Fortification (CONAFO) of Guatemala have been carrying out since 1994 a surveillance system of salt and sugar fortification programs. The system was introduced in response to the lack of reliable and objective information about the performance of these interventions in the country, as well as to monitor that fortified foods were reaching the final consumer.

Aims: Implement a permanent surveillance program to follow the evolution of the coverage and the quality (micronutrient content) of fortified salt and sugar in the country.

Methods: Four hundred and twenty schools were selected randomly from the total rural public schools in the country. Every year, school teachers of the Ministry of Education take 20 samples of sugar and salt from each school to complete around 4,000 samples of each food. All samples are analyzed using a quality control method to determine the presence of the micronutrient, the percent of positive samples is interpreted as the coverage. Two composite samples are prepared per school, using only the samples with positive results, and they are analyzed with quantitative methods.

Results: The percentage of samples with micronutrient levels of biological importance to have an impact in population is calculated, and the product fortification quality is estimated through the distribution of the micronutrient content. Results are presented by region and depicted in charts and maps to visualize the regions where population is at risk of not getting well fortified salt or sugar. Every year, results are published along with results of food control by the Ministry of Health and the social-auditing system by the Consumers Protection League. A public conference to inform about the status of the fortification programs in the country is also organized.

Conclusion: Presence of fortified sugar has risen from 30% in 1994 to more than 90% in 2007, along with the increment in the vitamin A content. The performance of salt fortification program has fluctuated between 31% in 2001 and 76% in 2006. The annual cost of the whole system is approximately US$54,000, which has been covered by UNICEF.

Conclusions: The constant information and the associated pressure to keep attention in these fortification programs have contributed for improving compliance by the industry, strengthening the inspection activities by the Ministry of Health, and raising the awareness of the population toward these nutritional interventions. Although both programs have been constantly threatened due to political and economic interests, the presence of this surveillance system has been a key factor for the programs’ survival and therefore for the continue benefit to the national public health.

W42	IMPACT OF VITAMIN A AND D3 FORTIFIED OIL ON NUTRITIONAL STATUS OF MOROCCAN WOMEN IN REPRODUCTIVE AGE AND PRE-SCHOOL CHILDREN

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Background: In Morocco, a survey conducted in 1996 by the Ministry of Health and its partners had shown that 40.8% children of 6 to 59 months of age had marginal vitamin A deficiency (plasma retinol < 0.70μg/dl), whereas vitamin D deficiency is more prevalent among adults. In addition, another regional survey in the same year had shown that 10.9% women (15-49 years) were vitamin D deficient. Consequently, the Moroccan government with the support of the USAID and then GAIN had set up strategies to fight against micronutrient deficiencies. Among these strategies, fortification of foods with vitamins and minerals is the most logical. However, it has been decided to fortify oil with vitamin A and D3.

Methods: Two large-scale surveys have been conducted, the first in June 2006 and the second in January 2008. The surveys have covered 15 Moroccan regions and 3680 women/child were recruited each time. In addition, 1200 plasma retinol samples from women and children were analyzed by HPLC technique. Plasma C-reactive protein was analyzed to exclude inflammation cases.

Results and Conclusion:

<table>
<thead>
<tr>
<th>Vitamin A&amp;D3 deficiency prevalence</th>
<th>Children (6 to 59 months)</th>
<th>Women (15 to 69 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2006 June</td>
<td>2008 January</td>
</tr>
<tr>
<td>Retinol (μg/dl)</td>
<td>23.8% (n=390)</td>
<td>22.1% (n=368)</td>
</tr>
<tr>
<td>Fortified oil</td>
<td>10.9% (n=494)</td>
<td>7.4% (n=510)</td>
</tr>
<tr>
<td>Retinol (μg/dl)</td>
<td>40.4% (n=1431)</td>
<td>27.8% (n=390)</td>
</tr>
<tr>
<td>Fortified oil</td>
<td>n.d.</td>
<td>22.3% (n=368)</td>
</tr>
<tr>
<td>Fortified oil</td>
<td>25.0 (±275mg/kg)</td>
<td>n.d.</td>
</tr>
</tbody>
</table>

The results seem to be in favor of a successful vitamin A oil fortification program.

W43	IMPACT STUDY ON THE CONSUMPTION OF WHEAT FLOUR FORTIFIED WITH ELECTROLYTIC IRON ON IRON STATUS OF THE MOROCCAN POPULATION

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Background: The National Food Fortification Program instituted with assistance from GAIN was a response to the high micronutrient deficiencies and its consequences on the most vulnerable in Ghana. The program Aims at fortifying all wheat flour produced and imported to the country with iron, vitamin A, folate acid, other B-vitamins and zinc, and vegetable oil with vitamin A. There is a comprehensive monitoring and evaluation component that focuses on capturing data on the whole fortification process from factory to consumer end. It establishes a mechanism for data capture, reporting and feedback beyond the project implementation period. The key components of the ME plan include: Internal and external monitoring of supply of prema and production of fortified wheat flour; and processing and packing of fortified vegetable oil.

Methods: Three surveys were conducted; The first in June 2006; The second in January 2007 and the third in January 2008. These surveys have covered 15 regions in Morocco among 16. Hemoglobin, plasma ferritin and C-reactive protein were analyzed. Results on anaemia status are shown in the table below.

Conclusions: Results show a slight improvement in iron status. The evaluation of iron status in Moroccan population should be carried out again once total industrial flour is fortified.

W44	ENSURING SUCCESSFUL FOOD FORTIFICATION THROUGH EFFECTIVE AND COMPREHENSIVE MONITORING

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1Nutrition Dept, Ghana Health Service, Accra, Ghana, 2Food and Drugs Board, Accra, Ghana, 3Global Alliance for Improved Nutrition (GAIN), Geneva, Switzerland

The National Food Fortification Program instituted with assistance from GAIN was a response to the high micronutrient deficiencies and its consequences on the most vulnerable in Ghana. The program Aims at fortifying all wheat flour produced and imported to the country with iron, vitamin A, folate acid, other B-vitamins and zinc, and vegetable oil with vitamin A. There is a comprehensive monitoring and evaluation component that focuses on capturing data on the whole fortification process from factory to consumer end. It establishes a mechanism for data capture, reporting and feedback beyond the project implementation period. The key components of the ME plan include:

1. Internal and external monitoring of supply of prema and production of fortified wheat flour; and processing and packing of fortified vegetable oil
2. Assessment of availability, utilization and coverage at distribution points and household levels and includes post market survey(PMS) as well as tracking the outcome of social marketing and communication designed to generate demand and promote utilization
3. Assessment of outcome and impact measures such as fortified food consumption and micronutrient status. Specifically the objective is to assess the adequacy of vitamin and mineral content; estimate proportion of food vehicle being fortified and determine the access and impact of consuming fortified wheat flour and vegetable oil on vitamin A, iron and folic acid status of children aged 2-5 years and women in reproductive age group.
4. The scope of the existing inspection activities at production sites, by regulatory agencies and health service monitoring has been expanded to cover the fortification process. As of the end of year there an impact evaluation which is set to employ before and after design will be done. A baseline survey that assessed both biochemical and dietary measures has been completed. Key indicators include quality of fortifications, level of micronutrients in flour and oil, knowledge of benefits of fortification, ability to identify logo and associated messages, consumption of wheat flour products and oil, and access to fortified foods.

Results from on-going factory inspection, market surveys and evaluation of radio campaign showed successful implementation. It is expected that this will be sustained to improve consumption of fortified products especially among children 2-5 years and women of childbearing age, particularly pregnant women to improve their survival.
EvidEncE-basEd Programs

Micronutrients, HealTh and DevelopMent:

Wednesday, 13 May, 2009 Food Fortification

abstracts

and monitoring is easier for authorities.

Future plans for sugar iron and zinc fortification are possible.

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decreasing the fortification program cost in more than 40%. Now in Guatemala above 95%

contemplates the vitamin A degradation and sugar shelf time. This approach allows more

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revealed that according to the usual sugar consumption an adequate vitamin A intake is 5 ppm.

Aims: A protocol was established in 2002 by the Guatemalan Sugar Industry and signed by

the Guatemalan Health Authorities with the Aims to increase above 90% of adequately fortified

sugar and decrease the cost of the fortification program.

Methods: To ease the fortification process, the degradation rate of the vitamin A and the

sugar shelf time before final consumption were studied. Consequently a fortification level was

established to assure that at time of final consumption the sugar would have more than 1 ppm

of vitamin A. Results: Previous to the establishment of the sugar vitamin A fortification protocol

studies revealed that according to the usual sugar consumption an adequate vitamin A intake is 5 ppm.

As well research showed that vitamin A decays to a rate of 1 ppm per month and the sugar

shelf time before final consumption is two months. Since 2002 the strategy was to centralize

the fortification process in six package centers according to the local sugar market demand.

In the package centers the fortification operative process is more effective and specialized

than in the sugar mill factories. At the present the target level of fortification (8 to 10 ppm)

contemplates the vitamin A degradation and sugar shelf time. This approach allows more

than 5 ppm of vitamin A in the sugar at time of consumption and save vitamin A feedstock,

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Conclusions: The protocol established between the Guatemalan Sugar Industry and the

collaboration of the Guatemalan Health Authorities to establish the guidelines for the sugar

vitamin A fortification improved the population vitamin A nutritional intake, consequently

decreasing the incidence of blindness. The centralization of the fortification process is more
effective, with higher quality control and monitoring is easier for authorities.

IMPROVEMENT AND STATUS OF THE SUGAR VITAMIN A

FORTIFICATION PROGRAM IN GUATEMALA, CENTRAL AMERICA

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Guatemala, Guatemala

Background: Guatemala is the fifth world producer of sugar, where most of it is for exportation

and the local market is completely satisfied. In many countries sugar is fortified with Vitamin

A (retinol palmitate) to prevent blindness incidence and help population health; Guatemala

among them began its sugar vitamin A fortification program in 1970. In the beginning of the

program, sugar was fortified in the sugar mills factories and the level of fortification varied

along time from 5 to 15 parts per million (ppm) of vitamin A. In time some inconvenience in the

fortification process and non-acceptance of the vitamin A observed.

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effective, with higher quality control and monitoring is easier for authorities.

INFLUENCES OF MULTI-NUTRIENTS FORTIFIED FLOUR ON SERUM LEVELS OF FOLATE, HOMOCYSTEINE AND VB12 IN CHILD BEARING AGE WOMEN IN HIGH NTD AREA IN CHINA

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Objective: The observation of influence of fortified flour on serum levels of folate, homocystein

and VB12 in Child bearing age women was carried on in Luliang area, with high nortrobate
deficiency prevalence in Shanxi province, China.

Method: 218 women, aged from 18-39 in 13 townships were voluntarily selected as subjects

and divided into two groups. 155 subjects as the intervention group had consumed fortified flour

which are fortified with retinol chloride, riboflavin, folic acid, NaFEDTA and zinc oxide for 20

months, 63 subjects as controlled group consumed none fortified flour during the observation

period. Serum folic, homocystein and B12 were measured in both groups after observation.

Result: The level of folate of intervention group was 11.1 ng/ml that was significantly higher

than 8.1 ng/ml in control group (p<0.01). Homocystein levels of intervention and control

groups were 12.91 μmol/L and 21.77 μmol/L, respectively and the difference was remarkable

(p<0.01). VB12 levels in intervention group and control group were 220.5 pg/ml and 173.5 pg/

ml that were low compared with normal level (187-1039 pg/ml) in both groups, but higher in

intervention group. After 20 months intervention prevalence of folate and VB12 deficiency in

intervention group and control group were 6.0% and 11.9%, prevalence of VB12 were 43.9% and

61.4% respectively while high homocystein rates in intervention group and control group were

24.3% and 69.5% respectively.

Conclusion: The observation suggested that fortified flour may increase the serum folate level

and decrease homocystein level in consummation child bearing age women. The increase of

serum VB12 level in intervention group by fortified flour without VB12 added explored a

question if improvement of other micronutrients could increase VB12 level that certainly

needs further researches.

EFFECT OBSERVATION OF FORTIFIED FLOUR ON SERUM LEVEL OF FOLATE IN NORTHWEST RURAL VILLAGES IN CHINA

H Huang, J Sun, J Huo, J Sun, J Huang, W Lee, L Selenje, G Gleason, Z Mei, X Yu

Institute of Nutrition and Food Safety, China CDC, Beijing, China, ZJNCF, Beijing, China, JCOMET

University, Beijing, China; ACIC, Beijing, China, SPICD, Beijing, China

Background: Flour fortification is considered an approach in control and prevent undernutrition

properly satisfied. In many in China, but evidence of bio-effect of fortified flour on risk

population may criteria for its further development. Reforestation policy, as protection project

for environment, applies free compensation such as wheat flour to villagers in 25 provinces including

mainly the northwest rural area. This flour fortification intervention project observed the effects

of fortified compensatory flour in two trial sites.

Objective: The purpose of this project was to accumulate scientific evidence of flour fortification

in Chinese population, to investigate the feasibility of development of flour fortification in

northwest provinces and further to promote national wide flour fortification in China.

Method: The observation conducted for three years on two intervention groups and two

control groups of population in two rural sites in Lanzhou and Chengde. 17,186 farmers in

both areas were covered by the observation and 9568 of them were composted with fortified

flour. 7 survey including baseline survey were carried out from year 2001-2007 and in each

survey, 300 female adult subjects aged 20-60 in each group were measured for dietary

pattern, height, weight, boy fat and Hb, serum retinol, SI, FEP, serum zinc and serum folic acid

with blood samples.

Result: The data showed the average consumption of fortified flour in the intervention groups

in the period were 117-260 through reformation project. Intakes of micronutrients (VA, VB1,

VB2, maxin, folic acid, iron and zinc of female adults increased up to the requirements compared

with Chinese RNI or AI. Nutrition status of VA, zinc and folic acid were significantly improved from

one year after till the end of the trial compared with both baseline surveys and control groups.

Both intervention groups showed a increased iron status and Hb, however the data suggested

NaFEDTA had a better effect than that of electrolyte iron at same fortification level on both Hb,

FEP and Hb. The result of the observation confirmed the positive bio-effect of fortified flour in

rural female popualtion in northwest China.

ABSTRACTS

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MICRONUTRIENTS, HEALTH AND DEVELOPMENT: EVIDENCE-BASED PROGRAMS
W49
MICRONUTRIENTS DEFICIENCY AND BENEFITS FROM DISTRIBUTION OF A HEALTH BEVERAGE

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While the macro and micro-nutrient deficiencies coexist in poor socio-economic groups of communities, it is found that micro-nutrient deficiencies (hidden hunger) are widespread even in middle and high income group of communities. The supplementary feeding programs in operation in the developing countries attempt to bridge the dietary gap of macronutrients i.e. energy and proteins. Programs to prevent specific micronutrient (MN) deficiencies like vitamin A, iron and iodine have addressed the problems only partially. Extent of deficiencies of these MN and their functional consequences are coming to be recognised. Food based approach is considered to be the best way to address these problems in the communities. An attempt was made to study the extent of deficiencies of several MN in a middle income segment of the population and the impact of supplementing MN in the form of a health beverage distributed in a placebo-controlled, randomised trial. Methods: In a community of 14 m in a residential school, information on baseline characteristics of growth, common morbidity, biochemistry, bone health and certain mental parameters on 869 subjects is presented. The results of the study showed widespread prevalence of MN deficiency and varied but definite benefit from the consumption of fortified health beverage in mean increments of height and weight, duration of illness. Significant improvement in vit.A, B2, B12, Folate, vit.D, Parathormone and TSH in supplemented children was also seen. Hemoglobin status improved only in children anemia to start with. Fat-free mass, VFA, whole body BMC, whole bone area and BMI at the neck of the femur were found to be significantly greater in supplemented group. With regard to mental function it was observed that attention concentration incremental scores to be significantly higher in supplemented children. Details of the study and the findings will be presented.

W50
EFFECTS OF MATERNAL MICRONUTRIENT SUPPLEMENTATION WITH ZINC AND BETA-CAROTENE ON MORBIDITY AND IMMUNE FUNCTION OF INFANTS DURING THE FIRST 6 MO OF LIFE IN A RANDOMIZED CONTROLLED TRIAL IN INDONESIA

F Wieringa1, M Dijkhuizen2, Muhilal3, J van der Meer4

FUNCTION OF INFANTS DURING THE FIRST 6 MO OF LIFE IN A RANDOMIZED CONTROLLED TRIAL IN INDONESIA

1International Centre for Diarrhoeal Disease Research, Bangladesh, GPO Box 128, Dhaka 1000, Bangladesh; 2Department of Women and Children’s Health, Uppsala University, SE-751 85 Uppsala, Sweden

Deficiencies of vitamin A and zinc result in >1 billion child deaths each year. Therefore, interventions which could improve vitamin A and zinc status of children are of high priority, and much attention is given to direct supplementation of children with zinc and/or vitamin A. However, in contrast to children > 1 yr of age, supplementation of infants with either zinc or vitamin A has proven less effective than originally hoped for in reducing infant mortality. Micronutrient supplementation of pregnant women might be an alternative way to improve micronutrient status of infants during the first months of life, thereby reducing infant morbidity and death. Moreover, maternal supplementation could benefit the newborn’s immune development already in utero.

Methods: To investigate effects of maternal micronutrient supplementation, mothers were supplemented during pregnancy with beta-carotene and/or zinc, in addition to standard iron and folac acid, in a randomised, double-blind controlled trial. Newborn infants (n=170) were followed-up for six income. Main outcomes were morbidity and immune responses of the infant at 6 mo of age.

Results: Infants born from mothers receiving zinc during pregnancy had significantly less episodes of diarrhea than infants born from mothers not receiving zinc (0.5 and 1.0 respectively) but more episodes of cough (2.0 and 1.9 respectively) during the first 6 mo. Maternal beta-carotene supplementation had no effect on infants’ morbidity. Furthermore, cytokine production of infants at 6 mo of age was significantly affected by maternal zinc and beta-carotene supplementation, with zinc supplementation giving 16% higher IL-6 production, and beta-carotene supplementation leading to 36% lower IFN-γ production.

Conclusions: Maternal supplementation with zinc and beta-carotene, in addition to iron and folic acid, affected the newborn’s immune development in distinct ways, but only maternal zinc supplementation significantly affected morbidity in the infants. Addition of zinc to standard iron and folic acid supplements for pregnant women could be an effective way to reduce diarrhoeal disease during the first 6 mo of life albeit at the expense of more episodes of cough. An enhanced pro-inflammatory immune response is a likely explanation. Larger studies are needed to confirm these results, and investigate effects on infant mortality, and in-depth studies are needed on the immune-modifying effects of zinc and beta-carotene, both in utero and in infancy.

W51
THE LONG-TERM RELATIONSHIP OF CORD BLOOD ANTIOXIDANT VITAMINS AND CHILDREN’S INTELLECTUAL DEVELOPMENT

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Background: Early nutritional status is one of the important long-term impact factors on children’s cognitive development and cognitive dysfunction is closely related to the equilibrium state of oxidation-anti-oxidation.

Objective: To measure the levels of antioxidant vitamins (Vitamin A, E and C) in cord blood and analyse the long-term correlation of the antioxidant vitamins during pregnancy and the intellectual development of infant and children.

Methods: A total of 150 paired mother-neonatal subjects were recruited to present study. These vitamin concentrations in mother blood after delivery and cord blood were determined by HPLC and the intellectual development was evaluated by Gesell Development Schedules and WPPSI in 2 and 5-year old child, respectively.

Results: The maternal, adaptive and average development quotient of WPPSI in high cord blood vitamin E group were significantly higher than those of low cord blood vitamin E group (p<0.05). After adjusting the effect of sex, education level, income, environmental tobacco exposure and delivery Methods: on intellectual development, the motive development quotient increased about 4 scores with one pg/mL elevation of cord blood vitamin A concentration. Meanwhile, vitamin E level in cord blood showed a positive relation with motive and adaptive development quotient in Gesell (p<0.05). Moreover, the vitamin E transfer ratio of mother to fetus had a statistically positive correlation with language, individual-social behavior development in Gesell and operation IQ in WPPSI (p<0.05).

Conclusions: The maintain of sufficient antioxidant vitamins status during pregnancy, may be long-term favorable impact on intellectual development.

W52
MULTIPLE MICRONUTRIENT SUPPLEMENTATION DURING PREGNANCY WAS NOT ASSOCIATED WITH GROWTH OF INFANTS AND YOUNG CHILDREN IN RURAL BANGLADESH

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Many studies suggested that antenatal multiple micronutrient (MMN) supplementation is better than iron and folic acid (IFA) supplementation to prevent low birth weight, fetal loss, and early infant mortality. However, very little is known about the benefits of antenatal MMN supplementation on growth during infancy and early childhood. We investigated the effects of MMN supplementation during pregnancy on growth of infants and young children in the Maternal and Infant Nutrition Intervention in Matlab (MINIMat), a large intervention trial conducted in rural Bangladesh. We followed 1343 children from birth to 24 mo of age, who were born to mothers in the MMN intervention study. Mothers of these children received either one type of IFA (IFA with 60 mg iron or IFA with 30 mg iron) or MMN during pregnancy. Weight and length of the children were measured monthly in the first year and quarterly in the second year of life. Anthropometric indices were calculated relative to the 2000 WHO Child growth standards.

Growth trajectories were modeled using multilevel models for change controlling for possible confounders. Mean birth weight was 2677 ± 401 g. Rate of low birth weight (<2500 g) was 30%. Mean body weight at 6, 12 and 24 mo was 6.7 ± 0.9 kg, 7.9 ± 1.1 kg and 9.7 ± 1.3 kg, respectively. MMN supplementation was not significantly associated (p = 0.719) with subsequent weight and length gain in this cohort. Attained weight, length, and anthropometric indices from 1-24 mo were not significantly higher among the children of mothers who received MMN than the children of mothers in two other groups. Proportions of underweight and stunting were not significantly lower in children of mothers who received MMN. Our results suggested that antenatal MMN supplementation was not effective for growth of infants and young children in rural Bangladesh. Targeting infants and children for MMN supplementation to prevent childhood undernutrition may be an effective strategy as the complementary foods in developing countries are deficient in micronutrients.

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**W53**

**IRON AND ZINC SUPPLEMENTATION DURING INFANCY AND COGNITIVE FUNCTION 8 YEARS LATER AMONG THAI CHILDREN**

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**Background:** Iron and zinc are important micronutrients for child growth and development, particularly early in life. Iron and zinc supplementation has been shown to benefit cognitive function in infants. One would expect that iron and zinc supplementation in infancy would be an appropriate strategy to promote long-term cognitive development and school achievement, but this strategy has not been evaluated.

**Aims:** The aim of this study was to investigate the impact of iron and/or zinc supplementation during infancy on cognitive performance 8 years after supplementation.

**Methods:** A follow-up study was performed among 560 9-year-old children in a rural district of Khan Kham, Thailand. These children had participated in a randomized controlled trial involving 4 groups receiving daily 10 mg iron, 10 mg zinc, 10 mg iron and 10 mg zinc, or a placebo at 4-6 months of age for a duration of 6 months. The children examined represent 93% of those participants in the earlier study. The bias that occurred was similar across all four groups.

 Cognitive development was assessed using the Wechsler Intelligence Scale for Children Third Edition, WISC-III, Thaivisa. Raw scores were transformed to the intelligence quotient (IQ) according to the country norms. Analysis of variance (ANOVA) was used to assess the long-term impact of supplementation on IQ. Multiple regression analysis was performed to assess whether the effects of supplementation on IQ would be differ by biochemical and anthropometric status at baseline.

**Results:** Results show no significant differences among the 4 supplementation groups for the full scale, verbal, and performance IQ at 8 years after supplementation. The IQs of children ranged from 92.9 to 93.4 for full scale IQ, 93.7 to 95.1 for verbal IQ, and 92.9 to 93.7 for performance IQ. There were no significant effects of supplementation on IQ by different status of biochemistry and anthropometry at baseline.

**Conclusions:** Supplementation with iron and/or zinc during infancy does not lead to long-term cognitive improvements in 9-year-old children.

**W54**

**MODIFYING EFFECTS OF WEALTH ON THE RESPONSE TO NUTRIENT SUPPLEMENTATION IN PREGNANCY ON BIRTHWEIGHT, DURATION OF GESTATION AND PERINATAL MORTALITY IN RURAL WESTERN CHINA: DOUBLE-BLIND CLUSTER RANDOMIZED CONTROLLED TRAIL**

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**Background:** Preterm birth and low birth weight are closely associated with neonatal mortality in developing countries. Maternal nutritional deficiencies remain the major contributor to low birth weight in poor rural populations. We assessed the modifying effects of household wealth on the response to nutrient supplements in pregnancy on newborn anthropometry and perinatal mortality.

**Methods:** A cluster randomized double-blind controlled trial was conducted in the rural northwest China. All pregnant women in villages were randomly allocated to either daily supplement from enrolment until delivery of folic acid, iron/zinc acid, or multiple micronutrients (MMN). A wealth index which was constructed from an inventory of 16 household assets or facilities using a principal component analysis method was categorized into tertiles as an indicator for the poorest (the lower 33%) and richer (the upper 66%) households. The primary outcomes were both anthropometry and duration of gestation, and secondary outcomes were perinatal mortality. Analysis was by intention to treat with GEE models to adjust for the cluster randomized design.

**Findings:** In the poorest pregnant women, MMN significantly increased the duration of gestation by 0.29 weeks (95% CI 0.04-0.54), reduced the rate of low birth weight by 44% (RR 0.56, 95% CI 0.32 to 0.97) and reduced to early neonatal mortality by 52% (RR 0.48, 95% CI 0.17 to 1.36) compared to folic acid alone. Iron/zinc acid also significantly increased the duration of gestation by 0.49 weeks (95% CI 0.21-0.69) and reduced the preterm birth by 44% (RR 0.56, 95% CI 0.32 to 0.69) and significantly reduced early neonatal mortality by 90% (RR 0.10, 95% CI 0.01 to 0.79) compared to folic acid alone. In the richer women, MMN and iron/zinc acid had a non significant effect on birth weight, duration of gestation and perinatal mortality. MMN and iron/zinc acid increased the maternal hemoglobin concentration in third trimester birth in the poorest women (3.5g/dL, 95% CI -1.9- 3.3 in iron/zinc acid, 1.7g/dL 95% CI 0.1- 3.3 in MMN) and the richer women (5.1g/dL, 95% CI 1.6 - 8.6 in iron/zinc acid, 6.3g/dL, 95% CI 3.3 - 9.7 in MMN) compared to folic acid.

**Interpretation:** Women from poorer households had higher responses of perinatal outcomes to antenatal micronutrient supplementations in rural populations in China. Nutrient supplementation in pregnancy in rural China, especially among the poorest women, has an important role in play in improving perinatal health outcomes. The WHO recommended iron/zinc acid supplements appear to provide more protection for neonatal survival than MMN.

**W55**

**THE EFFECT OF MICRONUTRIENT SUPPLEMENTS ON BIRTHWEIGHT IN LOMBOK, INDONESIA: SUPPLEMENTATION WITH MULTIPLE MICRONUTRIENTS INTERVENTION TRIAL (SUMMIT)**

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**Background:** SUMMIT has reported that maternal antenatal supplementation with multiple micronutrients (MMN) tended to increase mean birthweight by 21g and reduce LBW by 18% compared to iron/zinc acid. The effect was larger and significant in women mothers with increases of birthweight of 2kg and reductions in LBW of 33%. Statistically significant increases were also found with infants whose mothers had higher mid upper arm circumference. This paper examines the modifying effects of maternal characteristics and seasonality on the birthweight response to MMN.

**Methods:** Three data sets are from SUMMIT conducted on Lombok, Indonesia from 2000-2004. From this trial, a sub-sample of infants was selected based on the following criteria: weight within 72 hours of delivery by midwives at SUMMIT staff and using a calibrated midline scale, SECA infanthand, or ultrasound from UNICEF. This yielded 16267 children with birthweights from the SUMMIT cohort, of which 6995 were born of women who had received the iron and folic acid (IF) supplement, and 7288 were of women given MMN. Subgroup analysis was conducted based on maternal height at enrollment, pre-pregnancy BMI, and birth weight at enrollment.

**Results:** Subgroup analyses showed that MMN increased birthweight by 37g in short women as opposed to 11g in taller women, while the risk of LBW in short women was reduced by 21%, while infants of women, whose last pregnancy resulted in stillbirth, were 88g heavier and had a 31% reduction in the risk of LBW if they had received MMN although none of these results are statistically significant. MMN supplementation in infants born between November and March showed no difference in birthweight, whereas infants born between April and October were 37g heavier with reduced risk of LBW in 30%. Adjusted analysis indicated an overall increase of 6.5g (95% CI 2.1 to 10.9, p=0.027) in birth weight in the WMN group after allowing for time of weighing, twin status, gestation at birth, infant’s sex, maternal height at enrollment, weight gain, maternal mid upper arm circumference, mean compliance, gestation at enrollment, socioeconomic characteristics, history of miscarriage and season of birth.

**Conclusions:** There was a tendency for the effect of MMN to be larger in shorter women, women with a history of stillbirth and babies born between April and October.

**W56**

**MATERNAL VITAMIN A SUPPLEMENTATION DURING PREGNANCY HAS NO IMPACT ON BLOOD PRESSURE IN PRE-ADOLESCENT CHILDREN IN RURAL NEPAL**

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**Background:** Exposure to retinoids in utero may have an impact on cardiovascular health in later life.

**Aims:** To examine whether maternal vitamin A supplementation before, during and following pregnancy affected the resting blood pressure and pulse of their children at ages 9 through 13 years in rural southern Nepal.

**Methods:** We reviewed a cohort of children whose mothers had been enrolled prior to conception and randomized by community to receive weekly a supplement of performed vitamin A (3000 mcg retinol equivalents), beta-carotene (42 mg), or placebo for 3½ years (1994 to 1997). Of the 16,996 infants born to mothers who participated in the original trial, 14,111 (74.3%) had survived and were living in the study area in 2006. We successfully followed and obtained resting blood pressure measurements on 13,090 (92.8%) of these children between September 2006 and March 2008, using an automated oscillometric device (O-Bopen 100, VSM MedTech Ltd, Coquil, Canada). The device automatically inflates and records multiple measurements at one-minute intervals. At least 3 measurements were taken and the mean of these recorded. Hypertension was defined as a systolic blood pressure of > 140 mm Hg, and diastolic blood pressure of > 90 mm Hg. Only two children were above both 140 and 90 mm Hg.

**Results:** Mean systolic and diastolic blood pressure was 97.3 ± 6.3 and 64.6 ± 8.5, respectively. Hypertension was rare with 5 (0.4/1000) children having systolic pressure above 140 mm Hg, and 56 (4.3/1000) with diastolic blood pressure > 90 mm Hg. There were no statistically or clinically meaningful differences in blood pressure or prevalence of hypertension between the children whose mothers received vitamin A, beta-carotene or placebo.

**Conclusions:** In this South Asian rural cohort of pre-adolescent children, there is no evidence that antenatal and postnatal (lactational) exposure to vitamin A or beta-carotene via maternal supplementation affects resting blood pressure.

Funded by the Bill and Melinda Gates Foundation, Seattle, WA, USAID, Washington DC and the Sight and Life Research Institute, Baltimore, MD.
W57 EFFECTS OF MATERNAL VITAMIN A SUPPLEMENTATION ON MOTOR AND COGNITIVE DEVELOPMENT AMONG SCHOOL-AGED CHILDREN IN RURAL NEPAL: A 10 TO 13 YEAR RANDOMIZED TRIAL FOLLOW-UP STUDY

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Background: Vitamin A supplementation shortly after birth and in early childhood can reduce infant and child mortality. Maternal vitamin A supplementation may, in some settings, reduce maternal mortality. But the developmental consequences of vitamin A deficiency, and benefits of its control, in fetal and infant life are unknown. Retinoid acid, the metabolically active substrate of vitamin A, is concentrated in the early developing mammalian hindbrain and motor neurons. Animal experiments reveal learning behaviour to covary with maternal vitamin A exposure. However, no human studies have evaluated the effects of maternal vitamin A prophylaxis on cognitive and motor development of offspring.

Aims: This study evaluates the effect of early vitamin A supplementation on child cognitive and motor development among a cohort of 10 to 13-year-old children (mean age = 11.45, SD=0.74) in rural Nepal. These children were born to women participating in a randomized, placebo-controlled trial of vitamin A supplementation before and during pregnancy and through six months post-partum.

Methods: Two teams of trained psychologists are assessing children using the Universal Nonverbal Intelligence Test (UNIT) and an abridged version of the Movement Assessment Battery for Children (MABC). The MABC tests ball skills, balance and manual dexterity, with four subtests scored on a scale of 0 to 5. Additional covariates related to nutritional, health and socioeconomic status are being measured.

Results: To date, field psychologists have tested 34% of a targeted sample of boys and girls (n=141 of a planned sample of 428). Field work is due to be finished in December 2008. Planned analyses will examine differences between children, according to their maternal supplementation group, in intelligence test scores, motor skills, and behavior.

Conclusions: This follow-up study of a randomized trial cohort, when completed, will provide the first evidence of any latent effect of early life exposure to vitamin A, achieved by maternal supplementation, on early adolescent cognitive, motor and behavioral development in an undernourished population.

Funded by: The Bill and Melinda Gates Foundation, Seattle, WA, the National Institutes of Health (RO1 HD35053), the Council of Health, Nutrition and Family Welfare, USAID, Washington, DC.

W58 EFFECTS OF MATERNAL MULTIPLE MICRONUTRIENT SUPPLEMENTATION ON MOTHERS’ COGNITION AND CHILDREN’S DEVELOPMENT

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Background: Examining the potential benefits of maternal multiple micronutrient (MMN) supplementation is important to inform policy decisions concerning maternal and child health programs. Two outcomes that may be improved by maternal MMN supplementation are maternal cognition and child development, since micronutrients are necessary for brain maintenance and function in adulthood as well as for fetal and infant development.

Aims: To examine the effects of the Supplementation with Multiple Micronutrients Intervention Trial (SUMMIT) on concurrent maternal cognition and on subsequent child development, particularly in women who were anaemic (haemoglobin < 110 g/L) at enrolment.

Methods: SUMMIT was a double-blind cluster-randomized trial in Indonesia comparing the effects of a maternal MMN supplement to an iron and folic acid (IFA) supplement (1). A battery of cognitive tests assessing declarative memory, working memory, executive function, language, and reading, as well as tests assessing motor dexterity and mood were administered to 640 SUMMIT participants after an average of 25 weeks of supplementation. A developmental test battery assessing motor development, language development, non-verbal cognitive development, and socio-emotional development was administered to 487 children of SUMMIT participants at 42 months of age.

Results: Mothers who received MMN scored significantly higher compared to IFA in overall cognition and reading performance in particular. The benefit of MMN supplementation on both scores was greater in undernourished and anaemic women. Children whose mothers received MMN scored significantly higher in motor development. In undernourished women, children of mothers who received MMN scored higher than IFA in overall development, and in motor development and non-verbal cognitive development in particular.

Conclusions: These data suggest that MMN supplementation can improve maternal cognition and children’s motor development. Maternal MMN supplementation seems to be especially important for anaemic women, to improve cognition, and for undernourished women, to improve their cognitive function as well as the cognitive and motor development of their children. This evidence supports maternal MMN supplementation as a beneficial program for pregnant women and their children.

W59 SUBCLINICAL IRON DEFICIENCY IN VENEZUELAN CHILDREN FROM 6 TO 48 MONTHS
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Background: Iron deficiency is a worldwide public health problem. Children at early age are a high vulnerable group, especially when they live in low income populations with poor sanitary conditions. A large population group from Venezuela is under these conditions and prevalence of anemia is increasing but subclinical iron deficiency is not well known.

Aims: To identify subclinical iron deficiency in children aged 6 to 48 months from a Venezuelan low income population as the basis for a nutritional and educational intervention program to improve iron nutritional status.

Methods: Descriptive and transversal study on 541 children living in a economic deprived area of Valencia, capital of Carabobo state, 2007. Written consent was obtained from the child representative. Measurements and cutoff points for iron indicators were: Hemoglobin (Hb) by automated method (<11.0 g/dl), ferritin by IRMA (<12 µg/L), RS transferrin (RSTf) (>8.5 mg/L), RS transferrin-ratio (RSTf-Ratio >1.8) and C reactive protein (CRP) by nephelometry (>10 mg/L). Descriptive values and Mann-Whitney and Fisher tests were applied (p <0.05).

Results: 95% of families were living in poverty conditions. Children showed prevalence of 73.2% of iron stores depletion (ISD), 23.3% of iron deficient anemia (IDA) and 27.0% of anemia, being the most affected, those below 24 months of age (Hb: 68.6% and anemia:73.3%) but similar for ISD. All children with low ferritin values had deficient erythropoiesis (RSTf-Ratio over 2.2). In children with normal ferritin levels, Hb was 97.4% but 26.6% had ferritin values between 1.8 and 2.2. Prevalence of elevated CRP was 31%.

Conclusions: Subclinical iron deficiency was highly prevalent in these children, especially in those below 24 months of age. This data shows that there is important situation that should be intervened, through a nutritional education program for mothers. The most efficient indicator to detect deficient erythropoiesis was the RSTf-Ratio in comparison to ferritin or RSTf used separately. This ratio could become a invaluable laboratory test in order to distinguish between iron deficient anemia and iron deficient erythropoiesis.

W60 SUPPLEMENTAL MICRONUTRIENTS DO NOT ADD TO THE EFFECT OF AN IMPROVED LOCAL-INGREDIENT-BASED COMPLEMENTARY FOOD ON HEMOGLOBIN CONCENTRATION IN YOUNG CHILDREN WITH MILD-TO-MODERATE ANAEMIA
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Background: Strategies to control iron malnutrition include food-based strategies such as dietary diversification and food fortification, as well as nutrition education, public health and food safety measures, and finally supplementation. Although food-based strategies take the longest to implement, they are generally regarded as the most desirable and sustainable option, especially those using local ingredients.

Aims: To compare the effect of an improved, local-ingredient-based mush, consumed with or without a multiple micronutrients (MM) supplement on haemoglobin (Hb) concentration in young children.

Methods: A community based trial was conducted in rural Burikina Faso, including children aged 6-23 months with Hb concentration of 80-100 g/l, who were randomized to receive either the improved mush (MG, n=66) or the improved mush with MM (MMG, n=67), 6 days/week for 6 months. This local-ingredient-based, processed mush had energy density, iron and zinc contents of 100 kcal/100g, 2.6 mg/100 kcal, and 1.2 mg/100 kcal, respectively. In each of the two feeding sessions a child was supposed to receive 100, 150, or 275 ml if he was aged 6-8, 9-11, or >12 months. Children were provided with insecticide-treated bednets; those who had a Plasmodium falciparum (PF) positive-smear at baseline and/or at each monthly checking received antimalarial therapy.

Results: Mean (SD) baseline Hb concentration was 89.2 (6.5) g/L, 90.3 (8.4) g/L in the MG and MMG, respectively (p=0.42). It increased to 104.1 (11.4) g/L in MG (p<0.001) and 107.6 (14.7) g/L in the MMG (p=0.001). This corresponded to an increment of 14.9 (11.0) g/L in the MG and 17.3 (15.8) g/L in the MMG. The between group difference (95% CI) of 3.5 (-1.0; 8.1) g/L, in mean (SD) endpoint Hb concentration was not significant (p=0.13).

Conclusions: The improved mush should be efficient for the prevention of anaemia in young children. Though studies are needed to determine the best ingredient treatment process that leads to the best iron content and bioavailability. Flour and mush production must enter the improved mush contents of 103 kcal/100g, 2.6 mg/100 kcal, and 1.2 mg/100 kcal, respectively. In each of the two feeding sessions a child was supposed to receive 100, 150, or 275 ml if he was aged 6-8, 9-11, or >12 months. Children were provided with insecticide-treated bednets; those who had a Plasmodium falciparum (PF) positive-smear at baseline and/or at each monthly checking received antimalarial therapy.

W61 AN INTEGRATED ANAEMIA CONTROL PROGRAM AMONG PRESCHOOL CHILDREN IN MAURITANIA
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Background: Anaemia is a widespread public health problem associated with an increased risk of morbidity and mortality among preschool children. In Mauritania, the control of anaemia is among the major priorities of the national nutrition policy but the development of an integrated program is still not completely developed.

Aim: To analyze the process of the implementation of the anaemia control program among preschool children in Mauritania.

Methods: A review of the implementation process since 2000 was done. In 2002, a Fortification Rapid Assessment Tools (FRAT) study was conducted. In 2004, de-worming was integrated into Vitamin A supplementation (VAS) mass campaigns twice a year. In 2007, a study mapped the wheat flour industries and assessed their commitment to fortify wheat flour with micronutrients.

A study on anaemia prevalence was carried out in February 2008. Finding: The FRAT revealed that wheat flour has a great potential as vehicle for food fortification. Wheat flour was consumed by 92% of the 12-36 months aged children (50g per day of median consumption). De-worming was successfully integrated into VAS campaigns twice a year since 2004 with more than 80% coverage for each event. This activity was institutionalized through mass campaign. Its impact alone on anaemia prevalence is mitigated. The February 2008 survey revealed a very high prevalence of anaemia measured by hemoglobin. This prevalence (hemoglobin rate <11 g/dl) was 85% among 6-59 months. The prevalence of severe anaemia (hemoglobin rate <7 g/dl) was 9% with strong disparities among ecological regions. This data was used as an important advocacy tool for accelerating food fortification process and infant and young child feeding strategy as a way to combat nutritional anaemia. The promotion of exclusive breastfeeding for under-six months is intensified through various delivery channels (mass campaign, health system and community actor’s networks) in 2008. The Ministry of industry has set up food fortification alliance.

Conclusion: The last study on the industry assessment as a way to promote the wheat flour fortification and the implementation of infant and young child feeding strategy will contribute to the integrated control of nutritional anaemia among preschool children. In the meantime, Mauritania as a pilot country for REACH-Ending Child Hunger and Under-nutrition has an opportunity to significantly reduce the actual nutritional prevalence of anaemia.

W62 «HIDDEN HUNGER» IN CHILDREN IS AN OPEN ISSUE IN ARMENIA
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Background: Micronutrient deficiency, particularly iron-deficiency anaemia, is one of the significant public health problems among children in Armenia, reaching up to 65% in some regions (BSH 2005). Since 2004, WV-Armenia has implemented Medical Outreach Teams (MOT) funded by USAID and World Vision-US. MOT was designed to enhance access to quality Primary Health Care (PHC) services for 123 communities with about 88,000 people living in hard-to-reach areas of Armenia. Health programming in communities are synergized with other WV programs for food security, food diversification, water and sanitation, education and community empowerment interventions.

Aims: Improving the Nutrition status of women and children is one of the targets of this program, implemented through a community-based integrated approach covering prevention and early detection and management of iron-deficiency anaemia. The program worked with the mothers, educating them on child nutrition and appropriate complementary feeding with an iron-rich food, and teaching the skills to reduce the risk of worm infestation and diarrhea. A network of trained community peer educators promoted utilization of locally available iron-rich food. Community health care providers were equipped to monitor child growth and development as well as manage/follow-up the detected cases of anaemia and malnutrition. Iron supplementation was partially possible only during the first year of program implementation.

Methods: Knowledge Attitude Practice (KAP) survey was conducted at baseline and at the end of the project to assess the impact of the intervention. Data from an existing surveillance system was used to determine worm infestation and anaemia cases.

Results: Several key indicators, such as the increase in proportion of exclusively breastfed children from 33%-48%, proportion of children with balanced diet from 9% to 45% demonstrated program effectiveness. Current program Health Information System providing surveillance data for over 90,000 medical consultations over 5 years of program implementation indicates a two-fold reduction of iron-deficiency anaemia as well as six-fold reduction of worm infestation and diarrhea.

Conclusion: Control of micronutrient deficiencies may effectively enhance integrated PHC service and its synergy with cross-cutting interventions.

ABSTRACTS

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Anemia, Iron Deficiency and Iron Supplementation Interventions - Infants and Children

Wednesday, 13 May, 2009
Iron Intake in Mexican Children from 1 to 5 Years Old: Results from the 2006 National Health and Nutrition Survey in Mexico

W68

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Background: Mexico, as other Latin American countries, is undergoing a nutritional and epidemiological transition characterized by an increase in the mortality rates associated to chronic, non-transmissible diseases and in the prevalence of overweight and obesity. Conversely, morbidity and mortality related to acute infectious diseases have decreased significantly over the last decades. In addition, an important decrease in the prevalence of stunting (10.1% in 1988-1996) and anemia (4.3% in 1999 and 2006) in preschool age children has been documented. A significant proportion of children and women of childbearing age are affected by iron, zinc and other micronutrient deficiencies. These deficiencies have adverse effects on the growth and psychomotor development of children.


Methods: Dietary data from 3552 children younger than 5 years of age collected through 24-hour dietary recalls was used for the analysis. Nutrient intake was calculated using the food composition database from the National Institute of Public Health, taking into account the Mexican food composition tables.

Results: Total iron intake was 6.2 mg, of which 1.6% corresponded to heme iron (0.1 g). The Mexico City region was the highest intake of heme iron (6.1 mg, 3.2% of total iron intake), whereas the lowest intake corresponded to the Southern region (0.9 mg, 0.09% of total iron intake) (<0.01). The highest proportion of children at risk of iron inadequacy were infants 12-24 months old (28.4%) compared with older age groups (<0.05). Indigenous children had a higher risk for iron (22%) and zinc (18.5%) inadequacies compared with non-indigenous children (15.3%, p<0.05, and 16.7%, p<0.05, respectively).

Conclusions: Although adequacy of total iron intake is above the international recommendations (marginally 1999), a high proportion (98%) corresponded to non-heme iron. Besides it has been documented that the content of bioavailable iron in the diet of Mexican preschoolers is low (1.6%) in relation with their physiologic requirements (2.7% to 6% of total iron consumed). Thus, iron deficiency is still highly prevalent in this population. This information may help as a tool to focus interventions targeted to those that may benefit from food assistance programs.

Iron Deficiency Anemia in Infants: Effects on Humoral Immunity

W70

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Background: Anemia is one of the world’s most widespread health problems. It affects 2 billion people worldwide and is a significant public health problem throughout the developing world. Iron deficiency is one of the main health goal factors considered in The World Health Report 2002, with children aged from 6 to 24 months being among the most vulnerable groups. The mechanism by which iron, iron-deficiency and iron-deficiency anemia affect humoral immunity is controversial and probably multifactorial.

Aim: To assess the humoral immunity of infants with different iron status using ferritin, red blood cell distribution width (RDW) and serum iron as parameters, and the effect of IgM levels on serum iron concentrations.

Methods: A cross-sectional study was conducted on 100 of 110 term infants aged 6 to 12 months old seen at a public health unit in Goiânia, Brazil. A socioeconomic, demographic, breast-feeding, and anthropometric survey was performed. Hemoglobin, RDW, ferritin, serum iron, C-reactive protein, serum IgM and IgA. The data were analyzed using SPSS. Multiple linear regression analysis was used to identify factors associated with IgM levels.

Results: The main immunoglobulins whose levels were increased in anemic and non-anemic infants were IgM, IgG1, IgG3, and IgC4. These differences were significant in anemic infants and children who were not iron-deficient and non-iron-deficient infants did not differ in humoral immunity when iron status was used as a parameter. IgM levels were significantly higher in infants with reduced serum iron.

Conclusions: Iron deficiency and iron deficiency anemia did not reduce humoral immunity. Infants with reduced serum iron did not show decreased IgM levels and serum iron as parameters, and the effect of IgG levels on serum iron concentrations.

Iron Deficiency Anemia in Infants: Effects on Humoral Immunity

W70

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Conclusions: Iron deficiency and iron deficiency anemia did not reduce humoral immunity. Infants with reduced serum iron did not show decreased IgM levels and serum iron as parameters, and the effect of IgG levels on serum iron concentrations.
EFFECT OF COMBINING MULTIPLE MICRONUTRIENTS WITH IRON SUPPLEMENTATION ON HEMOGLOBIN RESPONSE IN CHILDREN: SYSTEMATIC REVIEWS OF RANDOMIZED CONTROLLED TRIALS

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Objectives: To study the effect of combining multiple (two or more) micronutrients with iron supplementation on hemoglobin response when compared with placebo and with iron supplementation, in children.

Data sources: Electronic databases, personal files, hand search of reviews, bibliographies of books, abstracts and proceedings of international conferences.

Review Methods: RCTs evaluating change in hemoglobin levels with interventions that included iron and multiple micronutrient supplementation in comparison to placebo alone or iron alone were analysed in two systematic reviews.

Results: 25 trials were included in the review comparing iron and micronutrient supplementation with placebo. The pooled estimate (random effects model) for change in hemoglobin with iron and micronutrient supplementation (weighted mean difference) was 0.65 g/dL (95% confidence interval 0.50-0.80, p<0.001). Lower baseline hemoglobin, lower height for age z score, non-intake of ‘other micronutrients’ and malarial non-hyperendemic region were significant predictors of greater hemoglobin response, and heterogeneity. 13 trials were included in the review comparing iron and micronutrient supplementation with iron alone. The pooled estimate for change in hemoglobin with iron and micronutrient supplementation (weighted mean difference) was 0.14 g/dL (95% confidence interval 0.00-0.28, p=0.04). None of the variables were found to be significant predictors of hemoglobin response.

Conclusions: Synthesized evidence indicates that addition of multiple-micronutrients to iron supplementation may only marginally improve hemoglobin response to iron supplementation alone. However, addition of ‘other micronutrients’ may have a negative effect. Routine addition of unselected multiple-micronutrients to iron therefore appears unjustified for nutritional anemia control programs.

Keywords: Anemia, Hemoglobin, Iron supplementation, Multiple-micronutrient supplementation, Meta-analysis.
W72  WEAKLY IRON AND FOLIC ACID SUPPLEMENTATION COUPLED WITH BIANNIAL DEWORMING REDUCES THE PREVALENCE OF ANEMIA IN ADOLESCENT GIRLS IN MADHYA PRADESH, INDIA


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Background: Iron deficiency anemia remains a major public health problem in India, particularly among pregnant women. Low iron stores before conception are the main cause of anemia during pregnancy. Therefore, there is a need to reduce the incidence of anemia among adolescent girls, before they complete their growth and become adult women. Recognizing this need, the Government of Madhya Pradesh launched with UNICEF support a weekly supplementation program with iron (100 mg) and folic acid (0.5 mg) and bi-annual deworming for adolescent girls 10-18 years old.

Aims: To assess the impact of the program after 16 months of implementation in the district of Shirpur, Madhya Pradesh. 

Framework: A 3.5 low income rural area (n=158) and urban (n=117) adolescent girls were included in the assessment. Supplement administration was supervised by school teachers and by the village workers of the Integrated Child Development Services (ICDS) both in urban and rural areas. Finger-prick blood samples were collected at baseline and after 16 months of supplementation. Compliance was measured through the assessment of the records kept by the teachers and ICDS workers over the 16-month period. Outcome: At baseline, the prevalence of anemia was 88% (87% and 91% in urban and rural girls respectively). At end-line (16 months later) the prevalence of anemia was 80% (81% and 75% in rural and urban girls respectively). Over 88% of girls took the supplements regularly. 92% of the rural girls and 95% of the urban girls took more than 50 supplements. A dose-dependent response was observed as the final Hb concentration in girls who took more than 50 supplements was significantly higher than that in girls who took less than 50 tablets. Only 5% of the girls reported side effects. 

Implications: The results of the assessment indicate that the program had a positive impact in increasing Hb concentration in girls and reducing the prevalence of anemia. This positive effect was particularly marked among urban girls. (22% reduction in anemia prevalence), probably due to higher levels of anemia at baseline and higher supplement intake, the latter related to better supervision in school-based programs (most of the urban programs) than in community-based programs (most of the rural programs). However, the prevalence of anemia after 16 months of implementation remained very high. These findings will form the evidence base for an improved adolescent control program in Madhya Pradesh with State government resources. Key words not in the title: community-based nutrition, rural and urban, supervised supplementation

W73  ADOLESCENT GIRLS' ANAEMIA CONTROL PROGRAM, GUJARAT, INDIA: SHARING EXPERIENCE

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Background: In June 2000 Adolescent Anaemia Control program was initiated as pilot in Vadodara district of Gujarat covering 65,000 girls. Program strategy was to provide once a week fixed day (Wednesday) supervised iron folic acid (IFA) supplements to all adolescent girls in Grade 8-12. In 2001 impact study revealed success of the program and based on the lessons learnt, it was expanded in phased manner to entire Gujarat State by the year 2005. Simultaneously anganwadi workers of urban Vadodara were motivated to initiate IFA supplementation for out of school girls on similar strategy. Schools. Simultaneously anganwadi workers of urban Vadodara were motivated to initiate IFA supplementation for out of school girls on similar strategy. Aims: The expected outcomes of the program are a) to ensure that 90% 5G and 70% Hb are provided weekly with iron and folic acid tablets and b) to reduce the prevalence of anaemia in girls by 50%.

Framework: The program was first implemented in Nalvi – the third largest district in the State of Maharastra. At baseline, the prevalence of anaemia in adolescent girls was 65%. Adolescent girls received IFA supplements weekly (100mg iron and 0.5 mg folic acid), deworming twice yearly, life skills training with factual information about anaemia prevention, and self reporting compliance cards. Outcomes: A total of 165,000 adolescent girls were enrolled in the program. At end-line, girls' knowledge about the major causes of anaemia and how to prevent it increased from 35% to 91%. The prevalence of anaemia showed a 25% reduction among tribal girls (from 69% to 52%), a 22% reduction among rural girls (from 63% to 49%), but no significant reduction was observed among urban girls (from 64% to 63%). Implications: Effective inter-departmental coordination (Health, Women and Child Development, Education, and Tribal Departments), life-skills training and self-monitoring of compliance by adolescent girls, and an effective social communication and mobilization strategy are identified as the three most important success factors in tribal and rural areas. The program is being scaled up to cover 120,000 additional adolescent girls in the tribal district of Nandurbar. The urban strategy - devoted to reach 160,000 girls from slums – has been completely resisted for improved coverage and impact in an additional 130,000 adolescent girls in the urban slums of Mumbai City. Importantly, the State Government has planned for the inclusion of adolescent anaemia control programs in the upcoming Reproductive and Child Health Program. Key words not in the title: community-based nutrition, rural and urban, supervised supplementation

W74  WEEKLY IRON AND FOLIC ACID SUPPLEMENTATION WITH BI-ANNUAL DEWORMING REDUCES SIGNIFICANTLY THE PREVALENCE OF ANEMIA IN OTHERWISE UNEQUIPPED ADOLESCENT GIRLS IN MAHARASHTRA, INDIA


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Background: Rapid growth and menstrual losses translate into high iron requirements in adolescent girls. In India, 90% adolescent Indian girls are anemic. Anemia control programs in India have traditionally focused on promoting the consumption of iron rich foods and the administration of iron and folic acid supplements to pregnant and lactating women and, to lesser extent, children. Adolescent girls have systematically been left out of these programs. The Department of Public Health of the Government of Maharashtra with UNICEF support launched the Nutritional Anaemia Control Program for Adolescent Girls in Nalvi district. The program reaches school going (SG) and non-school going (NSG) girls (14-18 yrs old), with particular emphasis on NSG girls in rural and tribal and urban slums. Aims: The expected outcomes of the program are a) to ensure that 90% 5G and 70% Hb are provided weekly with iron and folic acid tablets and b) to reduce the prevalence of anaemia in girls by 50%.

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W75  EVALUATION OF THE ADOLESCENT NUTRITION SERVICES PROGRAM FOR ANEMIA REDUCTION IN RURAL BANGLADESH

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Introduction: The Adolescent Nutrition Services Forum was implemented in large areas of rural Bangladesh by the National Nutrition Program (NRP) of the Government of Bangladesh targets adolescent girls with micronutrient supplements, deworming tablets and nutrition education to reduce prevalence of anemia. Addressing adolescent anemia is essential to ensure that girls enter pregnancy iron replete and to lower the risk of infant and maternal mortality.

Objective: To assess prevalence of anemia among adolescent girls in NRP areas and to identify factors associated with a lower risk of anemia among adolescents participating in the program.

Methods: Data were collected through Helen Keller International’s Nutritional Surveillance Project in collaboration with the Institute of Public Health nutrition among 900 unmarried adolescent girls living in NRP areas in 2007. Data collection included information on socio-economic status, dietary intake, morbidity and coverage of NRP adolescent services. Anemia was defined as hemoglobin concentration below 12g/dl. A dietary diversity score was calculated summing up subjects’ non-staple food intake (animal source, plant source, and non-staples) during the week prior to the interview.

Results: Overall 63.5% of the adolescent girls in NRP areas were anemic. 88.5% of adolescent girls were members of the NRP adolescent forum. Prevalence of anemia was significantly lower among members than non-members (members 46%, non-member 54%, P=0.023). Coverage of iron-folate supplements among member and non-member girls was 69% vs. 5%, and deworming coverage was 52% vs. 13% respectively (both P<0.001). Results of multivariate logistic regression among forum members found that economic factors and other covariates found that intake of a more diverse diet in the last week, access to TV, knowledge of preventing anemia symptoms (taking supplements, deworming tablets and eating good food) and factors that reduced iron absorption delivered through the program were associated with lower odds of anemia.

Conclusion: Participants of NRP adolescent girls’ forum had a significantly lower prevalence of anemia than non-participating girls. A combined approach of increased coverage of adolescent nutrition services to other areas, targeted food security interventions and behaviour change communication would contribute to further reduction of anemia among adolescent girls throughout Bangladesh.
W76  LOW IRON INTAKE AND ANAEMIA IN FEMALE ADOLESCENTS IN UGANDA’S BOARDING SCHOOLS

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Although Anaemia was ranked among the leading causes of morbidity and mortality of all admissions and out-patient cases in Uganda, little attention has been given to this significant public health issue among adolescent females. The countries demographic health surveys of 2001 (24.5%) and 2006 (48.9%) showed high anaemia (7.8 – 10.9 g/dl) prevalence among adolescent (15-19 years) females. The adolescent females in boarding schools have higher anaemia prevalence rates probably brought about by consumption of a seemingly balanced but restrictive diet. The diet may not be able to meet the increased iron needs of adolescent females as it mainly consist of phytate contain legumes and tightly cured mills, all of which are known to greatly inhibit iron bio-availability. A cross-sectional study involving 198 students in 6 schools in central Uganda. Dietary intakes were obtained using a self administered structured questionnaire including a 24-hour food recall on three non-consecutive days and the woof2 (1997) used to convert intake into nutritional content. iron intake (23.3 ± 11.7 mg/day) was significantly (P < 0.01) below the nation) RDA of 30 mg with the majority (68.5%) below this. Only 0.010% of iron was in the form of the more absorbable heme iron. Iron intake of iron absorption enhancers vitamin C (18.1 ± 36.8 mg/day) and meat, fish and poultry (9.7 ± 11.5 mg/day) was also low with 65.5 % having inadequate vitamin C intakes. Iron status (Hb concentration) was assessed using a hemocue and the means in all schools was significantly (P < 0.01) below the WHO cut-off for anemia (<11 g/dl). The anaemia prevalence (68.7%) in this group is indeed a serious public health concern as defined WHO (2001) if the country is to combat anemia, a whole lifestyle approach should be considered so as to ensure that the period of adolescence is utilized to develop adequate iron stores, ensuring that they enter the adult stage with sufficient loads to cater for the demands of pregnancy in the near future. We cannot afford to ignore such a significant public health issue in adolescents because the prevalence exceeds the 5% cut off point set by WHO (2001).

W77  SCHOOL-BASED IRON AND FOLIC ACID WEEKLY SUPPLEMENTATION PROGRAMS SIGNIFICANTLY REDUCE ANAEMIA IN ADOLESCENT GIRLS IN BIHAR…BUT MUCH REMAINS TO BE DONE

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Background: India has one of the highest prevalences of anaemia in adolescent girls worldwide. However, India’s national programme for the control of anaemia does not include adolescent girls as an eligible group for services. Therefore, it is important to build the evidence base about the need for and the feasibility of programs to control anaemia in adolescent girls. It is documented that anaemia is a risk factor for low school enrolment and high dropout rates due to the poor concentration ability and learning capacity of anaemic girls. To respond to this challenge, Government of Bihar is scaling up with UNICEF’s support a large-scale program to control anaemia and improve nutrition, health, and education outcomes in school-going girls.

Aims: The aim of the program is to make use of the school infrastructure to deliver evidence-based, low-cost, high-impact interventions for the control of anemia to school-going adolescent girls.

Framework: A total of 300,884 adolescent girls from 1,348 schools across 16 districts (provinces) in the state of Bihar received weekly supplements containing iron (100 mg) and folic acid (0.5 mg) for 52 weeks (one year) along with factual information on the etiology and prevention of anemia, dietary counseling, and counseling for addressing some social determinants of anaemia such as gender discrimination, discrimination in intra-household food allocation, and early marriage/pregnancy. A random sample of 1,953 girls from 80 schools was identified to assess the impact of the program. Outcomes: The evaluation shows that 85 percent of the girls took a weekly iron and folic acid supplement. Counseling versions in schools were attended by 94 percent of the girls and 91 percent of them took advice from teachers on how to overcome the potential side-effects associated with iron and folic acid supplementation. After a year of implementation (52 weeks) the prevalence of anaemia in adolescent girls decreased from 93 percent to 84 percent (11 percent reduction); high school performance rates improved from 16 percent to 24 percent. Implications: These positive results have been used as evidence base to leverage government resources for scaling up school-based anemia control programs for adolescent girls in Bihar. Assessments are underway to increase the impact of the program; the inclusion of bi-annual deworming, younger adolescent girls (before the onset of menstruation), and non-school going girls through the community-based integrated Child Development Services program are three major innovations being considered. Key words not in the title: school performance, non-school going girls.

W78  HEMOGLOBIN CONCENTRATION AND IRON STATUS AMONG INDIAN ADOLESCENT SCHOOLGIRLS ARE NOT RELATED TO RIBOFLAVIN STATUS BUT TO VITAMIN A STATUS

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Background: Anaemia is mostly caused by iron deficiency, while several vitamins are related to anaemia. Riboflavin and vitamin A are postulated to have relationship with anaemia or iron deficiency, however, data on adolescent girls are scarce.

Objective: To assess the relationship between status of riboflavin and vitamin A and iron among adolescent schoolgirls in Indonesia.

Methods: Three cross sectional studies were carried out in arbitrarily selected secondary schools in different locations, of urban slum and rural areas, during dry and rainy seasons. Subjects were 749 post-menarchal adolescent girls of schools that had not been involved in any deworming nor iron supplementation programs. Concentrations of C-reactive protein, hemoglobin, plasma ferritin, and retinol, as well as the erythrocyte glutathione reductase activity coefficient were assessed. We excluded girls with inflammation as indicated by plasma C-reactive protein >3mg/L.

Results: The prevalence of anaemia, deficiencies of iron, riboflavin and vitamin A were in the ranges 9-57%, 20-57%, 59-96% and 7-21%, respectively. Concentrations of hemoglobin or plasma ferritin were not related to riboflavin status across study sites or when all data were combined, with or without adjustment for vitamin A status. When all data were combined, hemoglobin concentration was lower among vitamin A deficient compared to non-deficient girls, while plasma ferritin concentration was positively associated with vitamin A status, whether or not adjusted for riboflavin status.

Conclusions: Hemoglobin concentration or reduced iron status are not related to riboflavin status but to low vitamin A status and vitamin A deficiency.

W79  COMMUNITY LED INITIATIVE FOR CONTROL OF ANEMIA AMONG UNMARRIED ADOLESCENT GIRLS FROM RURAL WARDAH, INDIA

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Objective: To evaluate the effect of “Community Led Initiative” for control of iron deficiency anaemia among unmarried rural adolescent girls (12-19 years) through weekly iron supplementation and health education.

Material and Methods: The present participatory action research was carried out in 23 villages of Primary Health Centre, Anji having population of 31,482. The study subjects were unmarried rural adolescent girls of age group 12-19 years. Community based organizations (CBOs) like 65 women’s self help groups, 20 Kishon Panchayat (RF) forum of adolescent girls and 27 Khon Vikas Manch (KVM, Farmer’s club) and 20 Village Coordination Committees (VCC – a representative committee of above mentioned CBOs) were formed in all villages to form a platform at community level for actions. In March 2008, needs assessment was undertaken by interviewing 326 adolescent girls by trained personnel by paying house to house visits. Hemoglobin examination of girls was done by using Hemoglobin color scale. Later, Community organizers made survey findings available to VCC members for facilitating discussion and decision making process on intervention package. The intervention package consisted of weekly ferrous sulfate (60mg) tablet supplementation and health education. After intervention, the follow up assessment was undertaken in July 2008 by triangulation of quantitative (survey) and qualitative (Focus Field Analysis, FFA) Methods.

Results: The overall prevalence of iron deficiency anaemia significantly declined from 73.8% to 54.8% (p<0.001). The overall mean hemoglobin also increased significantly from 10.0 ± 1.82 g/dl to 11.0 ± 1.47 g/dl (p<0.001). There was significant decline in moderate and severe anaemia among adolescents. As found in force field analysis with 28 CLICS dots of intervention, the main positive forces for program were co-operation from the adolescent girls and their mothers due to perceived benefits like, increased appetite, reduction in problem of scanty menstrues, tiredness and weakness. The only major negative force was side-effects like nausea and vomiting.

Conclusions: Community mobilization for once weekly iron supplementation and diet education could improve hemoglobin status of rural adolescent girls.

Keywords: Community mobilization, weekly iron supplementation, rural, adolescent girls, iron deficiency anaemia, health education.
W80

IS NUTRITIONAL ANAEMIA A RARE PROBLEM IN ETHIOPIA

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Background: WHO has categorized nutritional anaemia particularly iron deficiency anaemia as one of the top ten serious public health problems. Nonetheless, in Ethiopia, nutritional anaemia is documented as a rarity by few investigators despite the fact that the country being among the poorest and least developed countries, with a high burden of macro- and micronutrient deficiencies.

Aim: The continued controversies on the existence of the problem in the country necessitated this work with the aim to clarify the uncertainties and demonstrate the existence of nutritional anaemia using evidence-based findings.

Methods: A total of 270 clustered villages from 9 administrative regions representing different food staple diets in proportion to their size of population were selected from June to July 2005 using multi-stage cluster sampling method. In each cluster, about 100 women or a total of 27,000 reproductive women were considered. Of the total 27,000 eligible lactating women assessed for clinical anaemia through interviews and clinical observations, only 5 percent of them were who lactating mothers were selected systematically and assessed for haemoglobin (Hb) and serum ferritin (SF) status and qualitative information on dietary practice and consumption was also collected.

Results: The mean Hb was 12.9 gm/dl ranging from 6 to 22.0 gm/dl with an overall prevalence rate of 28.3% indicating the prevalence of a moderate public health problem. The mean SF level was 5.85 mg/dl (ranging from 0.70 to 24.4 mg/dl) with a prevalence rate of 49.8% for iron deficiency further substantiates the existence of nutritional anaemia. The overall prevalence rate of iron deficiency anaemia was 17.0%. The prevalence of all types of anaemia among the age groups between 31-49 years was higher and the difference noted however was statistically significant only for anaemia. Overall, the proportion of women observed with frequent consumption of animal sources of iron rich foods was uniformly lower (18.9%) than plant sources.

Conclusion: Moderate nutritional anaemia in the form of iron deficiency anaemia appears to be a problem and therefore, the need for improved iron supplementation to vulnerable groups is the way forward to achieve several MDG goals.

Keywords: anaemia, rectify, lactating, inadequacy, supplementation.

W81

DETECTING ANAEMIA PREVALENCE AMONG FRONT LINE HEALTH CARE PROVIDER AS THE FIRST STRATEGY FOR ANAEMIA CONTROL IN JHARKHAND STATE OF INDIA.

Padma Chakraborty, Sathyajith Reddy

Background: Government of Jharkhand State, India, has initiated on priority basis the anaemia control program among pregnant women within the broad program of reproductive and child health. Prevalence of anaemia among pregnant mothers was recorded to be as high as 77% in the survey conducted by ICMR Micronutrient project in three districts covering over 300 pregnant women. With the technical support from ICMR Micronutrient Program, the training is conducted for all front line health care providers using the government resources.

Aim: As a part of motivation and education to them, all frontline health workers’ haemoglobin testing was done to show them their level of haemoglobin and measure anaemia prevalence among the front line health care providers. Those found anaemic, would get treatment and would also get extra motivation to control anaemia among their clients’ pregnant women.

Methods: From nine batches of 15-20 health workers in each batch, total of 139 front line health care providers using the government resources.

Results: Of the total 139 health workers who were screened for anaemia prevalence using HemoCue 201 machine during the lunch break, the results were instantly shared with them. Three categories of health workers were identified, auxiliary nurse midwife (ANM) who are full time, government paid employees covering 5000 population, anganwadi workers (AWW), who are part time supervisor workers from women and child development department who are covering 100 population and volunteers categorized as others.

Conclusion: Anaemia has been neglected morbidity and even though there is a program in place, none of the health workers seriously considered that is in important problem. They did not know their own level of haemoglobin and this exercise proved very important to educate and motivate them for anaemia control.

W82

THE PREVALENCE OF ANAEMIA IN MEXICAN WOMEN LESSENED IN THE PAST SEVEN YEARS BUT STILL IS UNRESOLVED PROBLEM

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Background: Anaemia is a public health problem affecting millions of people producing grave consequences for human health and social and economic development. Severe anaemia in women is associated with a higher risk of perinatal morbidity and mortality, it is also associated to impaired cognitive and physical development in children and to low work productivity in adults.

Objective: To describe the prevalence and distribution of anaemia in Mexican women and to analyze their tendency in the last two Mexican National Nutrition Surveys of 1999 and 2006.

Material and Methods: Data of women (12 and 40 years old) from two National Nutrition Surveys carried out in 1999 (ENNS99), and (ENSANUT 2006) were retrieved for these analysis. Hemoglobin concentrations were measured in both surveys in capillary blood, using a portable photometer HemoCue (Hemocue Inc., Angelholm, Sweden). The prevalence of anaemia adjusted by socioeconomic profile (high, medium, and low) and by potentially explanatory variables were modeled by multiple logistic regressions; probabilities and 95% CI were estimated.

Results: The overall prevalence of anaemia was 20.2% (95% CI 15.9, 26.2%) for pregnant women and 15.5% (95% CI 14.7, 16.4%) for non-pregnant women. The prevalence of anaemia diminished from 1999 to 2006 in all three socioeconomic profiles by about 5 percentage points. Adjusted OR for adolescent women living in the Northern and Southern regions was higher than that of those living in Mexico City (~0.05). Other risk factor was belonging to low socioeconomic level (p < 0.06). For adult women parity greater than 3 was a significant risk (p < 0.05). Having Indian ethnicity or being beneficiary of food distribution programs was not associated with anaemia.

Conclusion: Anaemia in women of reproductive age continues to be a public health problem in Mexico, although of medium importance (medium = 5 – 19.9%) according to WHO grading for the prevalence of anaemia in non-pregnant women and in pregnant women (≥20%). In the 7 years period elapsed between 1999 and 2006 there was a 5.6% decrease for non-pregnant and 4.5% for pregnant women. If the changes observed between 1999 and 2006 continues at the same pace, there would be needed 8.4 and 9.6 years to reduce the prevalence of anaemia of non-pregnant and pregnant women, respectively, to acceptable rates (<6.0%). Regardless of the progress achieved in reducing anaemia in women of reproducing age it is far from being resolved.

W83

STRENGTHENING PROGRAM DESIGN AND PLANNING: THE CASE OF THE NEPAL MATERNAL IRON/FOLIC ACID SUPPLEMENTATION PROGRAM

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Background: In 1999 the prevalence of Iron Deficiency Anaemia among pregnant women in Nepal was 71%. In 2001 coverage with iron/folic acid (IFA) supplements was only 23%, with poor compliance considered to be a key constraint. IFA tablets were available only at health facilities and there was lack of awareness and counselling. In 2003-04, the Department of Health Services developed a program of intensified maternal micronutrient interventions that involved Female Community Health Volunteers (FCHVs) in awareness creation as well as distribution of IFA tablets. The program was launched in 5 districts with initial training and then incorporated into the routine activities of the government health care facilities and FCHVs.

Aims: To assess whether the coverage and compliance of IFA supplementation could be significantly increased and sustained for long time by introduction of a community-based intensification program.

Methods: Baseline, midline-1, midline-2 and endline surveys were done in the 5 districts of the phase-one program in 2001, 2004, 2005, 2006 and 2008 respectively to evaluate the program outcomes. In each round of enumeration, 160 pregnant women in 2nd trimester (P2T), 100 pregnant women in 3rd trimester (P3T) and 160 postpartum women (PP) were selected by using a two-stage sample design. The main indicators were coverage and compliance of IFA tablets among pregnant and postpartum women. Compliance was defined as consumption of at least 80% of prescribed IFA tablets.

Results: P2T, P3T and PP coverage with IFA supplements increased from 27%, 47% and 23% at baseline respectively to 56%, 86%, and 64% at endline. Compliance among women in P2T, P3T and PP increased from 9%, 29%, and 8% at baseline respectively to 56%, 86%, and 64% at endline. At national level, national IFA supplementation coverage had in 2006 (by when the program had already been introduced to 20 districts) rose to 59% (Nepal Demographic and Health Survey) compared to 23% in 2003.

Conclusions: The main drivers of the increase – a combination of greater ease of access to and supply of IFA tablets plus the awareness creation activities of FCHVs – are thought to have contributed significantly to the very positive increases in coverage and compliance. Following these positive results, the program has been expanded to 32 out of total 75 districts (as of December 2008) in a phased manner. The Department of Health Services now plans to introduce the program to all 75 districts by 2010.

Wednesday, 13 May, 2009

Anemia, Iron Deficiency and Iron Supplementation Interventions - Women

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12-15 MAY 2009 ~ BEIJING, CHINA
**W84** BARRIERS TO IMPROVE HIGH COVERAGE OF IFA IN PREGNANT WOMEN IN THREE EASTERN DISTRICTS OF UP (UTTAR PRADESH) INDIA

V Joshi, A Jain, P Kancha, S Vhatre

**Background:** Anemia is the second highest cause of maternal deaths in Asia (Lancet 2006; 367:1066-74). Universal IFA supplementation of 100 tablets to all pregnant women through government public health system is part of national anemia control strategy. Nation-wide population based survey data (National Family Health Survey III: 2005-7) for Uttar Pradesh has reported 51.6% anemia prevalence among pregnant women and 8.7% pregnant women have consumed IFA for 90 days or more in their index pregnancy.

**Aim:** To study and determine barriers to achieve high coverage of distribution and consumption of IFA (Iron Folic Acid) tablets among pregnant women.

**Methods:** All the processes like micro planning, supplies, identification and registration of pregnant women, administration of IFA supplementation, counselling and advocacy, recording and reporting of IFA distribution and consumption and delivery of other services in government system in 9 blocks of 3 eastern districts (2.28 million populations and 75518 estimated number of pregnant women) of UP are observed by A2Z (USAID Micronutrient Organization) with support of GOUP (Health and ICDS departments). Systematic support is also provided by A2Z and GOUP in terms of field coordinators and mentors to improve internal monitoring processes at all levels in identified districts.

**Results:** The gaps identified were inadequate micro planning, problem in supply chain management, unsystematic Methods of identifying and following pregnant women, gaps in recording and reporting of IFA distribution, no tracking of consumption of IFA, inadequacy of internal monitoring and lack of coordination between two key departments (Health and Integrated Child Development Scheme) responsible for delivering services to pregnant women.

**Conclusion:** Lessons learned in 3 eastern districts are likely to be relevant to the other sixty eight districts of the state. Substantial coverage of IFA is possible if leadership at state and district levels give priority to addressing operational constrains identified.

**W85** WEEKLY IRON-FOLIC ACID SUPPLEMENTATION REDUCES ANEMIA AMONG WOMEN OF REPRODUCTIVE AGE IN THE SEKONG PROVINCE OF LAO PDR

B Phengdy, K Montha, K Houaboun, J Rah, T Cavalli-Sforza

**Background:** The prevalence of anemia, which increases the risk of adverse birth outcomes among pregnant women, is high in Lao PDR affecting 37% of women reproductive age (WRA). Daily administration of iron during pregnancy has had little success due to low program coverage. Weekly iron-folic acid (IFA) supplementation has been shown to be an effective alternative strategy to prevent anemia in various Southeast Asian countries as well as elsewhere.

**Objectives:** To determine the effect of weekly IFA supplementation in reducing anemia prevalence among non-pregnant WRA in the Sekong Province of Lao PDR and to examine change in knowledge and intake of foods rich in iron following community-based nutrition education.

**Methodology:** The program targeted 830 WRA (12–49y) living in 9 rural villages and 1230 schoolgirls (12–19y) living in one district of the Sekong province. They received 60 mg of elemental iron and 3.5 mg of folic acid weekly for 28 wk. Information and education (IEC) materials on the causes, consequences, and the prevention of anemia were provided and community-based nutrition education was conducted each month. All subjects received 500 mg of mebendazole prior to the IFA supplementation. An evaluation of this pilot project was conducted among 364 secondary school girls and 599 non-pregnant WRA. Capillary hemoglobin, women’s knowledge and dietary consumption were measured at baseline and after 28 wk of intervention.

**Results:** At baseline, 34% of school girls and 49% of village WRA were anemic (hemoglobin <120g/L). By the end of the intervention, >90% of the subjects had taken ≥20 of the 28 tablets and the prevalence of anemia was significantly reduced to 13% and 29% among school girls and village women, respectively. After monthly education for 6 mo, women’s knowledge on the symptoms, causes, and prevention of iron deficiency anemia improved remarkably. For example, the percentage of women who were aware that IFA supplementation can prevent anemia increased from 1% to 99% among school girls and from 17% to 97% among village women (both p<0.05). Compared to baseline, more women reported consuming iron-rich foods such as meat (17% vs. 40%) and fish (31% vs. 67%) following the intervention (both p<0.05).

**Conclusion:** Weekly IFA supplementation was found to be a practical and effective method for reducing anemia in adolescent schoolgirls and village WRA in rural Lao PDR. Nutrition education using effective IEC materials remarkably improved women’s knowledge of anemia and intake of dietary iron sources.
RESEARCH TO PRACTICE: A MULTISECTORAL APPROACH TO PRODUCT DEVELOPMENT, RESEARCH AND GLOBAL DISTRIBUTION TO PREVENT MICRONUTRIENT DEFICIENCIES

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Background: According to Pakistan National Nutrition Survey 2001-02, nearly 48% children aged 6-23 months are anemic with nearly 37% having iron deficiency anemia. Fortifying home-available foods with SprinklesTM (containing 12.5 mg of iron and other key micronutrients) may be an effective and feasible strategy for addressing childhood anemia especially if it can be successfully integrated into the government sponsored Lady Health Workers (LHW) program.

Aims: To assess the effectiveness in reducing anemia among children aged 6-23 months by integrating SprinklesTM into LHW program in rural peri-urban Pakistan.

Methods: The study was conducted from October 2007 to April 2008 in district Naushero Feroze. To assess effectiveness, a pre-post intervention design compared before and after hemoglobin (HB) measurements among children who received SprinklesTM with counseling (Sprinkles group) and children who only received feeding advice (Control group) during routine LHW visits. To assess the operational feasibility of integrating SprinklesTM into routine LHW program, M&E visits were made to eligible households to assess the distribution and usage of SprinklesTM along with exit interviews of mothers at the end of the study. In-depth interviews were also carried out with LHWs and Lady Health Supervisors (LHS).

Results: A total of 613 children were included in the study at baseline, 308 in the SprinklesTM group and 305 in the control group. At endpoint, data were available on 269 children in the SprinklesTM group and 305 in the control group. The attrition rate was high (11% in intervention group and 13% in the control group) due to unforeseen migration. 96% of the intervention mothers reported ever using SprinklesTM with a mean of 44.4 saches per child (SD: ± 22.4). Nearly 57% mothers reported completing the full 60 sachets. Overall, 61% of the mothers liked using SprinklesTM and 61% stated they usually mixed it in the child's breakfast. Anemia prevalence was reduced from 96% to 56% in the SprinklesTM group, and increased from 40 to 49% in the control group. A rate of anemia recovery among the SprinklesTM group was twice as large as in the control group (24% vs 11%). There was also a significant trend towards higher Hb response with increasing consumption of SprinklesTM. Wide-distribution of SprinklesTM by LHWs to households was observed. The LHWs and LHS reported that the activity was challenging but feasible and doable.

Conclusions: The study indicates that the integration of a SprinklesTM intervention into the LHW program is potentially feasible and effective in reducing anemia.

MONITORING COVERAGE, PROMOTIONAL STRATEGIES, AND PERSPECTIVES OF FACTORS INFLUENCING SALES OF SPRINKLES IN RURAL WESTERN KENYA: THE NYANDO INTEGRATED CHILD HEALTH AND EDUCATION PROJECT (NICH)

Lbull, I; Miller, H; O'Shaughnessy, J; Aggray, A; Ochieng, C; O'Shaughnessy, J; Miller, H; O'Shaughnessy, J; Bullock, P; Suchdev, C

Aim: To describe monitoring of wholesale sales, household demand, promotional strategies, and perceived factors influencing Sprinkles sales among vendors.

Methods: Disproportional quantitative and qualitative research was undertaken, beginning in February 2007. Office records monitored wholesale vendor purchases, distribution of incentives and promotions. Biweekly household surveillance monitored retail household purchases for 9 months. Qualitative data collection included 14 focus groups and 66 key informant interviews with vendors. Quantitative data analysis calculated frequencies and qualitative data were analyzed for recurring themes.

Results: From July 2007-June 2008, wholesale sales trends were strongly influenced by initial enthusiasm and interest promotion, national elections and later violence, and free sachet and cup promotions. Vendors who lived closer to the wholesale office purchased more Sprinkles; in response a 2nd office was opened closer to remote vendors. Over 1 year, distribution increased from 31% to 80% at recruitment, average 33% of households purchased and/or received gift of Sprinkles during the prior 2 weeks. In qualitative, vendors reported the most important factors perceived to influence sales were Sprinkles knowledge, health benefits, formal trainings, community launches, consumer incentives, marketing cash flows, and consumer and vendor incentives. Reported major barriers to selling were lack of time and walking long distances in villages to sell. Vendors described inter-personal promotion of Sprinkles occurring formally and informally by vendors and among the population, and testimonials of positive experiences as powerful motivators. Vendors reported formal training was important and that untapped vendor spere incentive. Vendor sale incentives are vital to motivate vendors over time; consumer incentives were perceived to motivate sales, but changing the incentives was needed to maintain sales. Vendors reported changing consumer incentive guidelines to garner sales.

Conclusions: Monitoring informs trends in promotions and sales, and is critical for effective promotional strategy implementation. These data led to decisions to expand, implement more trainings and launches, limit free sachets, and ensure sufficient vendor and consumer incentives. Quality trainings and launches, repeated with wide access, are necessary for promotion by vendors and community members.

WEIGHT GAIN AND RETENTION IN WOMEN SUPPLEMENTED WITH ONE OF THREE SUPPLEMENTS WITH IDENTICAL MICRONUTRIENT CONTENT IN MEXICO

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Background: The Mexican health system is facing a challenge on how to tackle the public health problems in the population. In Mexico there is a consistence of nutritional problems related to deficiencies (i.e. anemia) and excess (i.e. obesity). One of the organized responses to nutritional deficiencies health related problems is the Oportunidades program in Mexico. This program delivers fortified food (Nutrivida) to pregnant and lactating women beneficiaries of the program. However, knowing that prevalence of overweight and obesity in women is increasing, it is of paramount importance to ensure that Nutrivida consumption is not associated with a greater risk to develop overweight and obesity in women and to look for alternative strategies to improve micronutrient status during pregnancy and lactation.

Aim: To evaluate the impact of three supplements with identical micronutrient content (Nutrivida (Nv), tablets (T) and Sprinkles (S)) on the weight change during pregnancy and early postpartum period in women beneficiaries of the Oportunidades program in urban Mexico.

Methods: Communities (18 per supplement) were randomly assigned to receive Nutrivida (Nv), T or S. All pregnant women (<25 weeks) beneficiaries of the Oportunidades program were eligible to participate. Supplements were delivered daily (90 days) from week 3 from recruitment through 3 mo postpartum and compliance recorded. We included in the study, qualitative Methods to evaluate the acceptability of the supplements.

Results: A total of 694 women were recruited and started supplementation (Nv = 224, T = 235, S = 235) and 571 of them (82%) finished the study. There was not statistically significant difference demographic and other characteristics at recruitment. There was no difference on weight change from recruitment to 37 wks of pregnancy (Nv 6.4 ± 3.7; T 6.3 ± 3.7; S 6.2 ± 3.4, p > 0.1), and to 1 mo (Nv 9.3 ± 3.4; T 1.0 ± 3.4; S 0.8 ± 3.4, p > 0.1), or 3 mo postpartum (Nv -2.1 ± 3.6; T -4.6 ± 3.9; S -3.9 ± 3.4, p > 0.1). There was no difference on distribution, and supplement consumption. Although women in the S group consumed a greater number of dosis during the study, compared to Nv (65.7 ± 40.4, T 57.5 ± 40.4, p < 0.02), women reported that tablets were the first choice because of their convenience and the absence of perceptible taste or smell.

Conclusions: Given that weight gain and retention did not differ, it is likely that women consuming Nutrivida display a similar amount of energy from the habitual diet. Considering the qualitative and quantitative analysis, tablets may be a more cost-effective alternative for the delivery of micronutrients in the Oportunidades program.
SCALING UP ZINC AS TREATMENT OF CHILDHOOD DIARRHEA IN BANGLADESH

TH05

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Background: There are 14.9 million (United Nations Population Division) 2007 under-five children in
Bangladesh. About 3% of them are reported to have had diarrhea in the past 2 weeks (BDHS 2004). It is estimated that one treatment could save the lives of 10,000 children per year in Bangladesh (Jones, Lancet 2008; 162: 67–71).

Program: The SUZY project launched by CCDB with support from the Bill and Melinda Gates Foundation has been, for the first time, providing zinc treatment for diarrhea in a large scale targeting the enter-under-five population in Bangladesh.

Objective: The objective of the SUZY project is to implement a zinc treatment scheme for Bangladesh

Description: CCDB, through the SUZY Project, purchased the patent license for dispensable zinc tablets with the recipe from Nutriset and subcontracted a local pharmaceutical company, AMI Laboratories, to produce the tablets in Bangladesh. Baby zinc dispensable tablet were launched in November 2004. To disseminate the program, zinc tablets with ORS for treatment of childhood diarrhea, a vigorous communication campaign is ongoing that aims to reach all segments of the Bangladesh population, including health providers, parents, opinion leaders and drug sellers.

At the beginning, all activities were planned and partially initiated in a bottom-up manner. However, since the key stakeholders included the Pediatricons and the medical community were by-passed, the program faced obstacles and could not start. The strategy was then changed and introduction of zinc tablets through the Pediatricons and other medical professionals was re-engaged, and the program became successful. A national policy was formulated in September 2006 incorporating zinc in the management of childhood diarrhea through the IMCI program. All IMCI training courses now include zinc in the management of diarrhea. In collaboration with the SUZY Project, and through the Planning and implementation committee of the Ministry of Health and Family Welfare, the IMCI Program is providing zinc tablets free to children with diarrhea. From November 2006 to February 2007, ACF sold more than 12 million zinc tablets with an annual growth of about 110%. According to a market research, 110,000 zinc tablets per day are approved. Only this amount of tablets is currently being produced. However, considering the total estimated episodes of diarrhea among all under-5 children, the requirement of zinc could be much higher than what is currently being produced in the country.

Conclusion: The relative greater coverage of zinc within the short time frame in Bangladesh compared to other countries has been possible because of (1) leadership of a research institute having credibility, (2) support from a major donor, (3) endorsement from the Pediatricians, and drug administration authorities (4) local production and marketing of the tablets, and (5) an effective communication strategy. To improve national coverage further, zinc should be included in the essential drugs list to make it available at all levels of health care. Along with ORS, zinc should be distributed free to the poor in all Government facilities including outpatient dispensaries. There is an urgent need for establishing a cell in the Ministry of Health for monitoring the procurement and distribution of zinc. The ongoing communications needs to be continued.

TANZANIA PUBLIC-PRIVATE PARTNERSHIP TO PROMOTE RATIONAL DIARRHEA MANAGEMENT

TH06

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Background: In Tanzania the WHO estimated more than 25,000 childhood deaths annually in 2004 due to dehydration from diarrhea, placing Tanzania in the top 15 countries for diarrhea-related mortality. Diarrhea is estimated to be the third largest individual cause of infant mortality in Tanzania after malaria and acute respiratory infection.

Aims: POZUN partners with the public sector, private sector, NGOs and donors to promote to caregivers improved diarrhea management, which includes oral rehydration therapy, zinc treatment, appropriate antibiotic use and continued feeding during diarrhea and to ensure that all portions of the population are reached.

Methods: To assure local supply, POZUN selected a partner, Sheryl, according to criteria including quality assurance, production capacity, extensive distribution and willingness to cooperate with the POZUN. The project provided technical assistance via US Pharmacopoeia, an organization that works to certify the quality, safety and benefit of medicines, to ensure the zinc’s quality. To assure demand, POZUN and Sheryl agreed on a marketing plan that targeted health providers via a range of activities, including regular health professional contacts with medical representatives, hospital and MOI Center meetings. In parallel, POZUN supported trade activations to supply drugstores with initial stock and motivate retailers to sell zinc treatment along with ORS. Simultaneously, the Ministry of Health (MoH) promoted improved diarrhea management within Tanzania.

Results: Sheryl has upgraded its quality assurance standards, developed registered the zinc dispersible tablet, distributed it in districts with 57% of the country’s population and has sold more than 250,000 treatment courses in 22 months in the public sector and another 14,000 courses to the private sector. The public sector received 1.2 million doses donated by UNICEF and is distributing them to health posts. The IMCI guidelines were updated to reflect a range of improved treatments for diarrhea, malaria and other diseases. However, the MoH has not released the revised guidelines to many health professionals due to budget constraints. The guidelines’ roll-out is expected to increase the uptake of the product.

Conclusions: In countries where the public sector provides a high percentage of health care, this program can catalyze demand, but support of the public sector is critical to long-term uptake.

INTRODUCING ZINC AS CHILDHOOD DIARRHEA TREATMENT THROUGH THE PRIVATE SECTOR IN NEPAL: RESULTS AND LESSONS LEARNED

TH07

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Beginning in 2005, Nepal’s MOH embarked the WHO/DACUK recommendation to integrate zinc into its diarrhea management program encouraging the launch of zinc treatment programs through both public health facilities and private sector channels. Support for these programs was provided by the U.S. Agency for International Development. The Social Marketing for Diarrheal Disease Control (POZUN) Project, implemented by Abt Associates in collaboration with Population Services International, led the private sector initiative. The private sector program focused on training private providers and pharmacists while public sector efforts focused on training and distributing zinc via female community health volunteers and public sector clinics. Multiple communications channels targeted caregivers and providers to ensure they understood that zinc together with ORT/ORS is the appropriate treatment for uncomplicated diarrhea, that inappropriate diarrhea treatments may be harmful, and where to obtain zinc. Initially, no appropriate zinc products were available in Nepal, but collaboration with local pharmaceutical manufacturers resulted in three companies producing and introducing zinc in the private sector by August 2007. A population-based research study conducted by the project in August 2008, surveyed samples of children under five years of age in 15 districts across the country. Multivariate analysis was used to identify factors influencing the use of zinc and assess the impact of the communication campaign. The study found that 15-40% of children with diarrhea in the past two weeks were treated with zinc. Zinc tablets were obtained from private chemists shops (32%), private sector health posts (29%), hospitals (18%), a female community health worker (17%) and 5% from grandparents who paid for the zinc product—50% on the radio and 15% via the television commercial. Television and radio were the most effective means of transmitting key messages to the population. Research also found that caregivers exposed to the media messages were twice as likely to have treated their children zinc and to have used it correctly for 10 days along with ORS or ORT. They were also much more likely to know where to purchase zinc (77% of those exposed vs. only 4% of those not exposed). The private sector program, although only active in 30 districts but covering 61% of the population for six months, successfully contributed to an increase in zinc use from 0.4% in 2005 to 15.4% in 2008. Of users, 73% correctly took zinc and ODS together, 64% correctly took zinc for the full 10 days, and 53% did both.

EFFECTIVENESS OF ZINC SUPPLEMENTATION PLUS ORAL REHYDRATION SALTS COMPARED WITH ORAL REHYDRATION SALTS ALONE AS A TREATMENT FOR ACUTE DIARRHEA IN A PRIMARY CARE SETTING: A CLUSTER RANDOMIZED TRIAL

TH08

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Introduction: Zinc is an essential mineral required for the healthy growth and development of the brain. Zinc deficiency is prevalent in children, particularly those living in developing countries. Zinc is a key player in intercellular signaling, and is required for the development of the immune system. Due to these functions, zinc is essential for the growth and development of children. It is also important in reducing the severity and duration of episodes of diarrhea in children.

Objective: The objective of this study was to compare the effectiveness of zinc supplementation plus ORS with ORS alone in the treatment of diarrhea in children.

Methods: A cluster randomized controlled trial was conducted in a rural setting in India. A total of 36 clusters were randomized, i.e., 18 intervention and 18 control clusters. The primary outcome was the proportion of children who were cured within 24 hours of treatment. The secondary outcomes were hospitalization rates, caretaking behavior, and household wealth and income.

Results: The cure rate of the intervention group was significantly higher than that of the control group (p <0.05). The reduction in hospitalization rates was also significant (p <0.05). The caretaking behavior, such as the amount of food and water given to the child, was significantly better in the intervention group (p <0.05). The household wealth and income were also significantly higher in the intervention group (p <0.05). The impact of zinc supplementation on the primary outcomes was much more pronounced in children 6-11 months of age than in children 12-23 months of age.

Conclusion: Zinc supplementation can significantly improve the effectiveness of ORS in the treatment of diarrhea in children. This finding has important implications for the design of future trials and for the implementation of policies and programs aimed at improving the health of children in developing countries.

Selected Oral Presentations

Thursday, 14 May, 2009

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MICRONUTRIENTS, HEALTH, AND DEVELOPMENT: EVIDENCE-BASED PROGRAMS

12-15 MAY 2009 • BEIJING, CHINA
GOLDEN RICE AS A FOOD SOURCE OF VITAMIN A

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Golden Rice (GR) is a transgenic product that is enriched with beta-carotene (β-C) genetically. To determine its vitamin A value, intrinsically labeled GR was obtained by growing plants in a nutrient solution containing 23% D2O. The GR β-C was enriched with deuterium with the highest abundance isotopomer peak at M+9. Healthy subjects were given a known amount of an oil capsule of 13C10-retinyl acetate as a reference dose, in addition to deuterium-labeled GR. Serum samples collected from the subjects were analyzed using advanced technology (GC/ECNCI-MS) for the enrichments of labeled retinol by monitoring the isotopomers M+5 (derived from GR) and M+10 (derived from 13C10-retinyl-acetate). By using the response to the dose of 13C10-retinyl acetate as reference, one completed study (n = 5) showed that the conversion efficiency of GR β-C was 3.8 ± 1.7 to 1 (Mean ± SD) by weight (GR β-C dose of ~1 mg). More vitamin A equivalency studies with GR are ongoing (GR with/without added dietary fat, etc). Results of these studies will be presented and will be discussed in the context of GR’s potential contribution to population-based vitamin A adequacy. (Funded by USAID, NIH DK60021, USDA 58-1950-7-707, 1950-5100-065-04, 6250-2150-042, and Syngenta Foundation).
**TH11**

### IRON BIOAVAILABILITY FROM A TRADITIONAL COMPLEMENTARY FOOD “KHICHIURI” CONSUMED BY PAKISTANI INFANTS; THE EFFECT OF ADDED ASCORBIC ACID AND HUMAN MILK INTAKE

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**Background:** Although human milk contributed significant quantities of ascorbic acid to infants’ diets in Dhaka, no enhancing effect on iron bioavailability was observed in a recent study (Davidsson et al. Am J Clin Nutr 2004;79:1073-7).

**Aims:** To evaluate the effect of added ascorbic acid and the influence of human milk on iron bioavailability from khichuri.

**Methods:** Erythrocyte incorporation of iron stable isotopes 14 days after administration was used as a proxy for iron bioavailability. Children (6-12 months) consumed 6 servings of khichuri; with ascorbic acid (labeled with 57Fe) and without ascorbic acid (56Fe). Iron bioavailability was also evaluated from test meals with added ascorbic acid, consumed with or without human milk.

**Results:** Geometric mean iron bioavailability increased from 8.1 to 15.1 % (n=9; p=0.002 paired Student’s t-test) and from 10.5 to 35.9 % (p=0.0001; n=10) after addition of ascorbic acid at 2:1 and 4:1 molar ratios relative to iron, respectively. Intake of human milk did not influence iron bioavailability from khichuri with added ascorbic acid (2:1); geometric means were 12.0 and 13.6 % (p>0.1).

**Conclusions:** Ascorbic acid is a potent enhancer of iron bioavailability when added to khichuri at molar ratios similar to those evaluated previously in Dhaka. These results thus indicate – indirectly – that components of human milk modify the influence of ascorbic acid on iron bioavailability from complementary foods.

**Financial support:** International Atomic Energy Agency, Vienna, Austria (Coordinated Research Project E.4.10.13).

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**TH13**

### CHEMICAL COMPOSITION AND SENSORY PROPERTIES OF IRON FORTIFIED CASSAVA GARI

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**Background:** For the past two decades, efforts have been made by the public health community and the food and agricultural sectors to combat iron and zinc deficiencies. In Africa, biofortified crops can be a cost-effective strategy for addressing iron and zinc deficiencies in diets (Berthelemy & Boix-Gimenez 2007). However, a major constraint to the successful implementation of biofortification is the acceptance and consumption of biofortified crops by the African population. Sensory evaluation of biofortified crops is important for understanding consumer preferences, which could influence the success of biofortification programs.

**Aims:** The objective of this study was to evaluate the sensory properties of iron-fortified gari and compare it to unfortified gari.

**Methods:** The study used 12 feeds of PSB Bi68 and PSB Bi68 (unfortified) and PSB Bi68 (fortified with 10 mg/kg NaFeEDTA). The rate of return on investment for iron fortified gari is 1.36.

**Results:** There were significant differences (p > 0.05) in taste, texture and odour of unfortified and fortified samples. In terms of overall acceptability, panelists rated unfortified gari samples higher followed by samples with 45 mg/kg NaFeEDTA. The rate of return on investment for iron fortified gari is 1.36.

**Keywords:** Iron fortification, Cassava, gari, properties, cost

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**TH12**

### THE BIOAVAILABILITY OF IRON FROM BROWN RICE AND MILLED RICE OF THE SAME VARIETY

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**Background:** Milled rice is the staple food among Filipinos and is mostly consumed three times a day. Therefore, rice as a source of iron can have an important role in the existing 37% prevalence of iron deficiency anemia in the country. Previous iron absorption studies in Filipinos from rice and rice-based meals were carried out on milled rice but none was done on brown rice of the same variety. This leads to the hypothesis that brown rice may be better than milled rice in terms of iron content.

**Objective:** To determine iron absorption from brown rice and brown rice-based meal, and milled rice and milled rice-based meal of the same variety.

**Methods:** The rice variety used in the study was 12 seeds of PSB Bi68. Iron absorption from brown/milled rice and brown/milled rice-based meals was determined in 12 healthy human subjects from the incorporation of radioactive iron into erythrocytes 14 days after administration of the labeled rice/rice-based meals. The above samples were also analyzed for nutrient content including dietary fiber, and iron.

**Results:** The iron content of brown rice was significantly higher (1.1±0.1 mg/100g) than that of milled rice (0.6±0.1 mg/100g). Brown rice has significantly greater amounts of total dietary fiber (6.6±0.4%) than milled rice (1.7±0.2%, P<0.05). Both tannic acid and phytic acid contents in brown rice (56.9±3.2 mg/100g and 2901±1.8 mg/100g, respectively) were significantly higher than that of milled rice (71.3±2.2 mg/100g and 84.0±1.2 mg/100g, respectively, P<0.05). The amount of iron absorbed (mg) from brown rice (0.13±0.02) did not differ significantly from milled rice (0.14±0.02). However, brown rice-based meal (0.16±0.04) differed significantly from brown rice (P<0.05) as well as milled rice-based meal (0.35±0.03) from milled rice (P<0.05). Moreover, brown rice-based meal did not differ significantly from milled rice-based meal (P<0.05).

**Conclusions:** Iron absorbed from brown rice and milled rice does not differ significantly as well as brown rice-based meal and milled rice-based meal. Differences in iron absorbed from brown/ milled rice and brown/milled rice-based meals may be due to the iron content of the test foods and the presence of iron-enhancers in the meal e.g. fish, vegetables and citrus fruit.

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**TH14**

### EVALUATION OF THE ECONOMIC FEASIBILITY OF A BIOFORTIFICATION INTERVENTION IN NICARAGUA

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**Background:** In Nicaragua, iron and zinc deficiencies affect more than 30% of the population, with serious implications for the country’s social and economic development.

**Aims:** The project aimed to estimate the cost-effectiveness of the development and dissemination of biofortified staple crops (rice, beans, maize and cassava) in Nicaragua compared with other approaches such as conventional fortification and supplementation in order to identify: 1) the most cost-effective intervention to combat iron and zinc deficiencies; and 2) its potential economic impact.

**Methods:** The Disability - Adjusted Life of Years (DALYs) methodology was used to estimate the number of productive years lost by a society in DALYs lost due to any given micronutrient deficiency in two scenarios—one with biofortification and the other without (the status quo).

**Results:** The difference between these scenarios is the potential impact of biofortification or the number of productive years that a society would save thanks to biofortification. To estimate the economic impact a monetary value was assigned to the DALY using the national per capita income.

**Conclusions:** According to the World Health Organization, supplementation and fortification interventions have a cost in Latin America per DALY saved of US$487 and US$215, respectively for iron and US$79 and US$27, respectively for zinc. In sum iron - biofortified beans, maize and cassava interventions have a cost in Latin America per DAL Y saved of US$487 and US$215, respectively for iron and US$79 and US$27, respectively for zinc. In sum iron - biofortified beans, maize and cassava interventions have a cost in Latin America per DAL Y saved of US$487 and US$215, respectively for iron and US$79 and US$27, respectively for zinc.

**Aims:** To determine iron absorption from brown rice and brown rice-based meal, and milled rice and milled rice-based meal of the same variety.

**Methods:** The rice variety used in the study was 12 seeds of PSB Bi68. Iron absorption from brown/milled rice and brown/milled rice-based meals was determined in 12 healthy human subjects from the incorporation of radioactive iron into erythrocytes 14 days after administration of the labeled rice/rice-based meals. The above samples were also analyzed for nutrient content including dietary fiber, and iron.

**Results:** The iron content of brown rice was significantly higher (1.1±0.1 mg/100g) than that of milled rice (0.6±0.1 mg/100g). Brown rice has significantly greater amounts of total dietary fiber (6.6±0.4%) than milled rice (1.7±0.2%, P<0.05). Both tannic acid and phytic acid contents in brown rice (56.9±3.2 mg/100g and 2901±1.8 mg/100g, respectively) were significantly higher than that of milled rice (71.3±2.2 mg/100g and 84.0±1.2 mg/100g, respectively, P<0.05). The amount of iron absorbed (mg) from brown rice (0.13±0.02) did not differ significantly from milled rice (0.14±0.02). However, brown rice-based meal (0.16±0.04) differed significantly from brown rice (P<0.05) as well as milled rice-based meal (0.35±0.03) from milled rice (P<0.05). Moreover, brown rice-based meal did not differ significantly from milled rice-based meal (P<0.05).

**Conclusions:** Iron absorbed from brown rice and milled rice does not differ significantly as well as brown rice-based meal and milled rice-based meal. Differences in iron absorbed from brown/ milled rice and brown/milled rice-based meals may be due to the iron content of the test foods and the presence of iron-enhancers in the meal e.g. fish, vegetables and citrus fruit.
TH15  IDENTIFICATION AND QUANTIFICATION OF MAJOR \( \beta \)-CAROTENOIDS IN SOME VEGETABLES

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**Background:** The vegetables analyzed in this paper are consumed worldwide. These vegetables are also grown, harvested, and consumed widely by the Middle East population. Jordan. The carotenoid contents of okra, green beans, zucchini, eggplant, tomato, and carrot have been determined in several countries; however, the results are somewhat diverging. More data obtained by reliable methods are needed even for these vegetables in order to differentiate natural compositional variation from analytical variability.

**Aims:** Determination of carotenoids in some common vegetables.

**Methods:** HPLC

**Results:** Neoxanthin, violaxanthin, and lutein were contained in all samples except tomato for neoxanthin, carrot, and tomato for violaxanthin and carrot for lutein. \( \beta \)-carotene was contained in all samples while \( \alpha \)-carotene was contained only in carrot. Lycopene was contained in okra, green beans, and tomato. Carrot had \( \alpha \)-carotene and \( \beta \)-carotene as principal carotenoids and lutein as a minor component. Relative high ratios (9-10 is to all-trans-\( \beta \)-carotene) of above 0.2 g/g were noted in green beans, eggplant, and okra.

**Conclusions:** This study focused on the quantification of carotenoids of vegetables commonly consumed in the Middle East countries, including Jordan. In general, the results obtained from this study agree with those reported in the literature, and the values fall within the wide ranges of data found in the literature. In any case, raw vegetables can provide high amounts of a variety of carotenoids that are important to human health.

TH16  INFLUENCE OF ENVIRONMENT AND CROP AGE ON \( \beta \)-CAROTENE CONTENT OF PROMISING ORANGE-FLESHED SWEET POTATO VARIETIES IN UGANDA

**Aim:** To establish variation of \( \beta \)-carotene levels in OFSP varieties across diverse environments as well as across different dates of harvesting in Uganda. Study design and methodology.

**Background:** Each of the 4 OFSP varieties was planted in 3 agricultural research stations in Uganda with different climatic conditions. OFSP samples were harvested monthly from 3 to 7 months after planting in Namulonge and Serere and from 5 to 9 months in Kachwara. For each genotype five roots were randomly picked from the field and submitted to the laboratory. The roots were washed, dried, peeled, and longitudinally quartered. Two opposite quarters of each root were combined, mixed, and homogenized. A weighed sample was taken for extraction and analyzed by HPLC method.

**Results:** \( \beta \)-carotene contents were significantly different (P < 0.001) among OFSP varieties. Goma had the highest levels of \( \beta \)- and total carotene while Kakomega had the lowest. However, \( \beta \)-carotene contents in OFSP varieties were not significantly different (P > 0.5) across the studied locations at 5 and 7 months after planting. Accumulation of \( \beta \)-carotene in OFSP increased with age from 3 to 7 months after planting. However, this increase was not significant (P > 0.5).

**Conclusion:** The environment has no significant effects on \( \beta \)-carotene content. Sweet potato varieties suggest that general nutritional recommendations can be made for specific varieties and not production sites. Piecemeal harvesting of OFSP varieties at 3 months is acceptable, however, maximum \( \beta \)-carotene can be obtained 4 months after planting.

TH17  THE EFFECT OF POLYPHENOLS FROM PHASEOLUS VULGARIS ON HUMAN IRON ABSORPTION

**Aim:** To investigate the influence of bean polyphenols on iron absorption in human subjects.

**Methods:** Stable isotope iron absorption studies were made in 3 groups of 16 women aged 18-45 years. The test meal was a phytate-free bread roll to which bean hulls were added to provide 20, 50, or 200 mg bean polyphenols. Beans were all phytate-free. Iron absorption was measured by erythrocyte incorporation of the isotope after 14 days.

**Results:** The addition of bean hulls to the bread roll inhibited iron absorption in a dose-dependent way. While 20 mg bean polyphenols had no effect on iron absorption (P = 0.92), 50 mg reduced absorption by 14% (P < 0.05), and 200 mg inhibited absorption by 45% (P < 0.0001).

**Conclusion:** Bean polyphenols inhibit iron absorption in humans in a similar way to polyphenols in common beverages and vegetables. The polyphenol content is high enough in some bean varieties to have a major inhibitory effect on meal iron. This is additional to the inhibitory effect of phytic acid. When biofortifying beans with iron, both phytic and polyphenol content must also be considered. The financial support from HarvestPlus is gratefully acknowledged.

TH18  EFFECT OF FOOD PROCESSING AND STORAGE ON THE STABILITY OF LYCOPENE AND \( \beta \)-CAROTENE IN TOMATOES VARIETIES IN MOROCCO AND ITS DERIVED PRODUCTS

**Aim:** Effect of cooking and storage on stability of lycopene and \( \beta \)-carotene in varieties fresh tomatoes and its products derived.

**Methods:** Five varieties of tomatoes the most consumed in Morocco (Guadilla, Ecoline, Volume, Rebeca, and Renz) and five types of tomatoes sauces. The samples underwent a treatment according to the Moroccan traditions and with five different types of temperature: 80°C, 100°C, 120°C, and 180°C (0, 5, 25 and 50 min). The quantification of lycopene and \( \beta \)-carotene was performed with method HPLC, with a reversed phase analytical C18 column, beta-spp- \( \beta \)-carotene was used as an internal standard during the extraction procedure.

**Results:** The content of lycopene and \( \beta \)-carotene depends significantly on the varieties of tomatoes. Indeed, this difference varies between 4.04 and 12.9 mg/100g for lycopene and of 1.53 and 3.2 mg/100g for \( \beta \)-carotene. The concentration of total lycopene was also increased following processing. 1. Heat induces isomerization of the all-trans to cis forms. The cis-isomers increase with temperature and processing time. 2. Less than approximately 10% isomerization of all-trans-lycopene to the cis form was noted.

**Conclusions:** These findings suggest that while lycopene is stable in the tomato matrix, sample handling techniques should be carefully evaluated to minimize the formation of lycopene cis isomers. This fruit (tomato) may be a good source of carotenoids such as lycopene and \( \beta \)-carotene in Morocco for prevention and therapy of human cancers and prevent cardiovascular diseases.
**ABSTRACTS**

**TH19**

**EFFECT OF DAILY CONSUMPTION OF ORANGE-FLESHED SWEET POTATOES ON VITAMIN A STATUS OF BANGALDESHI WOMEN OF REPRODUCTIVE AGE**

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**Background:** Vitamin A deficiency is prevalent among Bangladeshi women of reproductive age. Food-based approaches that provide small, safe amounts of dietary vitamin A may be a useful strategy for increasing the vitamin A status of this population group.

**Aim:** To assess the impact of daily consumption of orange-fleshed sweet potatoes (OFSP), with or without added dietary fat, on the vitamin A status of Bangladeshi women of reproductive age.

**Methods:** Non-pregnant, non-lactating Bangladeshi women with low plasma retinol (<1.05 umol/L) and normal C-reactive protein (<10 mg/L) (n=120) were randomly assigned to receive, 6 days/week for 60 days either: 1) 0 ug RAE as boiled white-fleshed sweet potatoes (WFSP) and a corn oil capsule; or 600 ug RAE as either 2) boiled OFSP and a corn oil capsule, or 3) boiled OFSP, sautéed in vegetable oil and a corn oil capsule, or 4) boiled WFSP and a capsule containing retinyl palmitate in addition to their usual home diets. Total body vitamin A pool size was assessed before and after the 60-d intervention, using the paired-deuterated retinol dilution technique. Plasma retinol and carotenoids were also measured before and after the 60-d intervention.

**Results:** Preliminary data indicate that initial and final mean plasma retinol concentrations were 0.74 ± 0.04 and 0.84 ± 0.03 umol/L, respectively, final mean did not differ by treatment group (n=76, p=0.55). Final mean β-carotene concentrations were higher in the groups that received OFSP with or without added dietary fat, 0.20 ± 0.12 and 0.26 ± 0.11 umol/L, respectively, than in the control and retinyl palmitate groups, 0.19 ± 0.05 and 0.09 ± 0.06 umol/L, respectively, (n=76, p=0.001). Estimates of total body vitamin A pool size and measurements of C-reactive protein concentrations are not yet available.

**Conclusions:** Preliminary data indicate that β-carotene was absorbed from boiled OFSP, with or without added fat, but had no effect on plasma retinol concentrations. Additional results for plasma concentrations of retinol, β-carotene and CRP, and results for mean change in 60-d intervention.

**TH20**

**PROMOTING VITAMIN A A SWEETPOTATO IN UGANDA: USING DEMAND CREATION TO MAKE THE LINK BETWEEN ORANGE FLESHED SWEETPOTATO (OFSP) AND VITAMIN A**

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In Uganda, national vitamin A deficiency levels for children under five years is 20% with considerable regional variation. Since 2006, HarvestPlus has been promoting beta-carotene rich OFSP in three areas of Uganda to address this deficiency. Although OFSP has been available in the country for several years, it has not gained wide acceptance partially due to a preference for white and yellow fleshed sweetpotato. This paper discusses how the HarvestPlus project has, through its demand creation program, systematically promoted the strong health link (Vitamin A with OFSP) in an effort to increase acceptance of this crop. Through a series of diagnostic studies, it was determined that one of the main reasons why OFSP has not been accepted is because it has been promoted primarily as ‘just another variety’ of sweetpotato. Through the Demand Creation program, a strategy was developed to incorporate the vitamin A message in all trainings with project extension workers, volunteer community promoters, community drama groups and local traders. The project logo and tag line makes explicit the link between OFSP and Vitamin A. As farmers and mothers are given vases for planting and they are also given nutritional training which emphasizes the link between OFSP and Vitamin A. Local sweet potato traders are trained in how to promote OFSP as a healthy choice to their customers. Other delivery platforms have been utilized so that community health workers who promote vitamin A as Child Health Days are also able to promote OFSP as a locally available and affordable vitamin A rich food. Primary schools are also a platform for reaching many young children who are then able to act as information channels to their parents. Community drama and radio spots not only deliver messages promoting OFSP but they also address barriers to acceptance in local communities. Results show farmers/ mothers are increasingly aware of the vitamin A message and are adopting the OFSP as a healthy food. Periodic participatory planning and evaluation meetings are used to help adjust and re-focus the project as needed. From this, HarvestPlus has refined its strategy for demand creation, that can be applied to other efforts to disseminate OFSP or other foods that are not readily accepted.

**TH21**

**PROMOTING ORANGE FLESHED SWEETPOTATO IN MOZAMBIQUE: THE DEVELOPMENT OF A RESPONSIVE NUTRITION PROGRAM FOR MOTHERS OF YOUNG CHILDREN**

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**Background:** In Mozambique, vitamin A deficiency affects up to 69% of children under five years. Since 2006, HarvestPlus project in Zambezia Province has promoted the growing and consumption of OFSP as a beta-carotene rich food to help address this deficiency. The project disseminates planting material to farmers and trains them in production of OFSP while stimulating the market through training traders about the nutritional benefits of OFSP and linking them to producers. Mothers Groups have been formed to train women in a range of nutrition and child care topics including infant and young child feeding, and promotion of vitamin A rich foods including OFSP.

**Objective:** This paper outlines the steps taken in designing a comprehensive and responsive nutrition training program that empowers the inclusion of OFSP as a vitamin A rich food suitable for children.

**Method:** The development of the current nutrition training program draws heavily on the past experience of the implementing agencies in promoting OFSP and community nutrition. Preliminary diagnostic field studies were designed to answer specific identified gaps in knowledge particularly about child feeding practices and cultural beliefs. A monthly supervisory and monitoring protocol was administered with extensionists and community volunteers to track progress against the training schedule. Knowledge retention tests were regularly administered to staff along with refresher training. Operational research studies were conducted to assess extensionist and promoter performance, knowledge retention amongst the community volunteers and mothers, and training needs of the groups.

**Results:** Based on the information gathered from various instruments, the training program was adapted to accommodate for low levels of education amongst mothers. Learning-by-doing (eg recipe demonstrations and practicals) and consistent visual aids were given more emphasis to reinforce key messages and to respond to expressed needs. It was observed that caregivers were able to change feeding practices when training sessions took into consideration food availability and seasonality. As influential groups (grandmothers) were trained, they reinforced key messages about breastfeeding and child feeding. Other findings showed that if the project messages were consistent with health and nutrition messages delivered through other platforms (eg Ministry of Health and radio) caregivers were more likely to accept and believe the message. HarvestPlus will now draw on this experience to develop a comprehensive and responsive nutrition program promoting other biofortified crops.

**TH22**

**THE POTENTIAL OF PROVITAMIN A BIOFORTIFIED STAPLE CROPS TO IMPROVE VITAMIN A STATUS OF PRESCHOOL AND ADOLESCENT CHILDREN IN DEVELOPING COUNTRIES**

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Efforts to improve vitamin A (VA) status globally have included supplementation and food fortification. Programmatic, food-based approaches to improve VA status are often overlooked. In part, this is due to perceived poor bioavailability of provitamin A carotenoids from fruits and vegetables and to costs associated with program implementation. Supplementation with preformed VA is expensive and does not support continued development of existing staple crops, through chyomicrons or enhanced antioxidant status of storage tissues. Fortification causes a gradual increase in VA liver reserves, but the potential for hyper-VA in individuals at the upper level of intake of the fortified food exists because it is delivered as the preformed vitamin. In an animal model, the bioconversion rate of β-carotene to VA decreases when liver reserves are adequate, mitigating the potential for hypertrovaemia. A food-based approach that uses provitamin A carotenoids. Biofortification of staple crops with β-carotene is an emerging strategy to improve VA status in groups at risk of deficiency. In this analysis, extrapolations from published human and animal studies estimated the potential of biofortified sweet potato and maize to improve VA status of a model boy and adolescent girl compared with supplementation or fortification. A male child (age 0.5 to 4 y) at the 50th percentile of weight-for-age and an adolescent girl (age 13-19 y), body weight 35 to 45 kg) were used to calculate liver size and VA accumulation in response to 60 intervention. Adequate Intake for infants and Estimated Average Requirements for children and adolescents were used as reference VA needs. A daily portion of sweet potato results in a higher relative increase in liver VA concentrations of infants than micronutrient sachets or tablets. In children, periodic supplementation results in a cyclic pattern of changing liver VA reserves. Fortification at published intakes causes a gradual increase in liver reserves but the potential for hyper-VA in children is high because it is delivered as the preformed vitamin. Biofortified maize consumption as a staple food causes a steady increase in liver VA concentrations in both models. The bioconversion rate of β-carotene to VA decreases when liver reserves are adequate, mitigating the potential for toxicity. In conclusion, provitamin A sources from multiple foods, including the biofortification of staple foods can improve VA status without the potential for hyper-VA. Biofortification is a long-term solution to improve VA status at the population level. Supported by HarvestPlus and the National Research Initiative of the USDA ORRI grant number 2003-35200.
ABSTRACTS

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TH24

BIOFORTIFIED COMMON BEAN GENOTYPES (PHASEOLUS VULGARIS, L.) AS IRON AND ZINC SOURCES IN BRAZILIAN POPULATION DIET

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The common bean (Phaseolus vulgaris, L.) has an important role as a source of nutrients (proteins, carbohydrates, vitamins and minerals) and dietary fiber for Brazilians as a product present daily at both rural and urban people’s diet. Regarding minerals, common beans are especially rich in potassium, phosphorus, copper, iron, zinc and magnesium. The bioavailability of minerals is relevant and normally lower in vegetables. Some factors can affect bioavailability such as food digestibility, chemical state of the mineral, other mineral content in the diet, the chelating agents present. Iron and Zinc are essential minerals for the human metabolism. Zinc has antioxidant properties and is part of many enzymes, influencing brain control of muscles and nervous system. These parental hybrids were selected for presenting higher total pro-VA content, ranging from 5.1 to 9.0 µg g-1 in the first generation (228 genotypes), hybrids with a carotenoid increment of more than 100% in relation to the parents were identified. Carotenoid premixes, Fe and Zn contents, inside the HarvestPlus program scenario. Initially, a total of 1800 cassava accessions, from the germplasm bank at Embrapa Cassava & Tropical Fruits, were screened. Total carotenoid contents in one-year old roots of the 72 landraces selected ranged from 0.63 to 15.51 µg.g-1 (fresh weight). Retention studies were carried out, at Brazilian Universities, in order to verify the β-carotene and total carotenoid losses in the usual Brazilian household cassava preparation. The production of bakery and extruded products, using biofortified cassava flour, was evaluated at Embrapa Food Technology. Researchers of Embrapa Maize and Sorghum implemented the quality protein maize (QPM), which has more lysine and tryptophan, than these QPM varieties, it is expected the development of maize with higher levels of pro vitamins A (10 – 12 ug.g-1), and zinc and iron. Some common beans genotypes were evaluated by Embrapa Rice and Beans, presented iron and zinc levels 50% and 43% higher than the ones of conventional cultivars, respectively; however, the productivity is still a challenge for the breeders. Also, a cowpea variety, with higher levels of iron was identified by Embrapa Mid-North and will be released in 2008. Six biofortified crops are being produced locally for sensory analysis and agronomical performances in Maranhao and Sergipe States, along with anthropometrical status. Results presented here are based on a team work strategy, integrating more than 150 people in different geographical areas, and working tightly in order to efficiently carryout HarvestPlus and Agroplus expected deliverables.

Keywords: Manihot esculenta-Crantz, carotenoids, biofortification program

TH25

BREEDING CASSAVA FOR ENHANCEMENT OF CAROTENOID IN THE BIOFORTIFICATION PROGRAM IN BRAZIL

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HarvestPlus is a network of research institutes in Latin America, Asia, and Africa which seeks to enhance the nutritional quality of food containing iron, zinc, and pro-vitamin A. The conventional crossing of different varieties of cassa, as also the identification and quantification of pro-vitamin A in three grains, have been the target of research by researchers at Embrapa Maize & Sorghum, through this biofortification program. In this sense, this work aimed to develop maize cultivars with higher pro-VA synthetic variety. They were crossed to generate all hybrids combinations. Parental hybrids planted in the nursery field ranged from 4.0 to 11.4 µg g-1 and averaged 7.2 µg g-1 (fresh weight basis). These selected lines were used to develop a pro-VA synthetic variety. They were crossed to generate all hybrids combinations. Parental hybrids planted in the nursery field ranged from 4.0 to 11.4 µg g-1 and averaged 7.2 µg g-1 in total pro-VA content (fresh weight basis). As expected, these partial results indicated pro-VA carotenoids content for this variety in this environment to be 7.2 µg g-1 (fresh weight basis). These parental hybrids were crossed and the seeds bulked. The bulked seeds were planted in an isolated field. About 100 plants were selected based on agronomic traits and 50 ears were already screened for carotenoids profile. For total pro-VA, total carotenoids, trans-β-carotene, retinol and lutein, the average values for the 50 ears (µg.g-1, dry weight basis) were 8.1, 138.8, 4.9, 3.6, 17.5, and 2.3, respectively, while, for the selected 10 ears, the average values were 10.1, 38.6, 4.4, 4.3, 20.2, and 3.7, respectively. A large degree of variation for carotenoids profile was observed. These partial results indicated the possibility for increasing simultaneously several components, such as total pro-VA, total carotenoids, trans-β-carotene and β-cryptoxanthin. The pro-VA averaged values for this synthetic is expected to significantly increase over the cycles of recurrent selection.

Keywords: Zea mays, carotenoids, biofortification, HarvestPlus

TH26

DEVELOPMENT OF MAIZE CULTIVARS FOR HIGHER PRO-VITAMIN A CAROTENOID CONTENT IN BRAZIL

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HarvestPlus is a network of research institutes in Latin America, Asia, and Africa which seeks to enhance the nutritional quality of food containing iron, zinc, and pro-vitamin A. The conventional crossing of different varieties of cassava, as also the identification and quantification of pro-vitamin A in three grains, have been the target of research by researchers at Embrapa Maize & Sorghum, through this biofortification program. In this sense, this work aimed to develop maize cultivars with higher pro-VA synthetic variety. They were crossed to generate all hybrids combinations. Parental hybrids planted in the nursery field ranged from 4.0 to 11.4 µg g-1 and averaged 7.2 µg g-1 in total pro-VA content (fresh weight basis). As expected, these partial results indicated pro-VA carotenoids content for this variety in this environment to be 7.2 µg g-1 (fresh weight basis). These parental hybrids were crossed and the seeds bulked. The bulked seeds were planted in an isolated field. About 100 plants were selected based on agronomic traits and 50 ears were already screened for carotenoids profile. For total pro-VA, total carotenoids, trans-β-carotene, retinol and lutein, the average values for the 50 ears (µg.g-1, dry weight basis) were 8.1, 138.8, 4.9, 3.6, 17.5, and 2.3, respectively, while, for the selected 10 ears, the average values were 10.1, 38.6, 4.4, 4.3, 20.2, and 3.7, respectively. A large degree of variation for carotenoids profile was observed. These partial results indicated the possibility for increasing simultaneously several components, such as total pro-VA, total carotenoids, trans-β-carotene and β-cryptoxanthin. The pro-VA averaged values for this synthetic is expected to significantly increase over the cycles of recurrent selection.

Keywords: Zea mays, carotenoids, biofortification, HarvestPlus
Agricultural-based Programs: Biofortification

**TH27 LOCAL VARIETY AS A SOURCE OF BIOFORTIFIED RICE IN BRAZIL**

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In Brazil, the activities of the Agrisalud Program on Biofortification is coordinated by the Brazilian Agricultural Research Corporation (Embrapa), which includes a number of research centers that are part of the biofortification network. The main food staples under research in this program are: cassava, sweet potato, rice, common beans and products made from these crops. The aim of this work, conducted at Embrapa Vegetables, was to study the carotenoid retention in orange flesh sweet potato flour during storage for sixty days. Quantifying this retention in orange flesh sweet potato flour during storage for sixty days is an important step in defining which flour production technology is more adequate since it defines the shelf life based on nutritional factors. Sweet potato is marketed as food. In order to quantify the retention of carotenoids in flour during storage, samples were packed in plastic bags and preserved the total carotenoid content for two weeks.

**TH28 CAROTENOID RETENTION IN ORANGE FLESH SWEET POTATO FLOUR DURING STORAGE**

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Carotenoids are pigments responsible for the color of vegetables; results of this study about the retention of carotenoids in orange flesh sweet potato flour are important to define the shelf life of this product. To achieve this goal, the experiment was designed to store samples of puree at different temperatures (15 and 30°C) for different periods of time (1, 2 and 30 days). The retention of carotenoids was measured using the absorbance at 450 nm (ε=66,000). The study was carried out in the Laboratory of Food Quality at Embrapa Rice and Beans. The results show that the retention of carotenoids is influenced by the storage conditions and that the retention decreases as the temperature increases or the storage period is prolonged.

**TH29 QUALITY EVALUATION OF ORANGE FLESH SWEET POTATO FLOUR IN STORAGE FOR TWO YEARS**

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Sweet potato is the 5th most consumed vegetable in Brazil, with a production of 400,000 tons per year. Part of the Agrisalud program, Embrapa Vegetables has been selecting clones with high beta-carotene (pro-vitamin A) content, aiming towards more availability of naturally enriched food, and targeting the poor masses, especially school-age children. Orange flesh sweet potato present high levels of beta-carotene. Its commercialization in the raw form make difficult to include it in basic food baskets and in food supplementation programs, such as school lunch. Transforming the roots into flour allows it to be stored for long periods without refrigeration. The objective of this work, conducted at Embrapa Vegetables, was to quantify the microbial occurrence in the flour after a long period of storage and also to evaluate its hygroscopicity, to verify if after this period the flour can still be considered good for consumption, even if the degradation of carotenoids occurs during storage. The steps for flour production are: peeling, slicing, drying, and grinding. Twelve samples of two sweet-potato varieties were packed in plastic bags and stored for two years, then six samples (3 lots × 2 varieties) were analyzed for microbial content (Bauchia cereus, Samonella, and Coliforms). Twelve samples of 1g were dried at 40°C, exposed to air and weighed at intervals of one hour, during six hours. According to the results, none of the samples presented contamination by Samonella or B. cereus. Only one sample presented coliform contamination, indicating inadequate handling during production. For hygroscopicity, the flour entered equilibrium after the fifth hour of exposure to air, presenting a final humidity of 12.2%. This value is considered adequate, based on the norms established for other flours.

**TH30 DEVELOPMENT OF MAIZE CULTIVARS FOR HIGHER ZINC AND IRON CONTENT AND BIOAVAILABILITY IN BRAZIL**

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This work aimed to develop maize cultivars with higher zinc and iron content and bioavailability, inside the HarvestPlus program scenario. Initially, 2009 QPM and normal endosperm inbred lines were screened for Fe and Zn content. A large degree of variation in maize grain content was observed with these materials. The screening of these samples ranged from 4 to 63 mg kg⁻¹ and 1 to 71 mg kg⁻¹ for Fe and Zn, respectively. Iron and zinc as phytic acid (PA) were determined in inbred lines, previously selected for presenting the highest iron or zinc concentrations. The PA percentage was determined according to the methodology described by Hsuw and Lantzsch (1983) and PA/Fe and PA/Zn molar ratios were estimated. Genetic variability was observed for PA levels, which ranged from 0.50 to 1.40% Iron and zinc concentrations were also determined applying atomic absorption spectrophotometry and ranging from 13 mg kg⁻¹ to 36 mg kg⁻¹ and 19 mg kg⁻¹ to 40 mg kg⁻¹, respectively. PA/Fe molar ratios in the samples ranged from 16.3 and 45.5, and PA/Fe molar ratios between 16.9 and 43.5. A partial diallel and partial QPM diallel (214 entries × 6 flint lines) was established in Northwestern Brazilian environments (Mata Rama Teresina) for on site evaluation. The hybrids presented zinc content in the grains varying within 21.4 and 31.8 mg kg⁻¹ with 27.7 µg g⁻¹ in average, while PA/Fe molar ratios in the samples ranged from 20.4 and 31.8 and averaged 24.6. The general combining ability (GCA) effects for zinc content ranged from -3.4 to 1.7 mg kg⁻¹ and from -1.3 to 2.5 mg kg⁻¹ for the dent and flint groups, respectively. The GCA effects for PA/Zn molar ratios ranged from -2.1 to 2.4 and from -1.1 to 2.2 for the dent and flint groups, respectively. Thirty-one (31) normal endosperm hybrids were evaluated in 2 Northwestern Brazilian environments. Hybrids were shown to have zinc content in the grains from 20.7 to 28.7 mg kg⁻¹ with 24.5 µg g⁻¹ in average, while PA/Fe molar ratios in the samples ranged from 24.4 and 34.1 and averaged 28.6. These preliminary results indicated that the development of synthetic varieties and hybrids may be based on parental lines with high combining ability for Fe, PA/Fe molar ratios rather than Zn and Fe content.

**Keywords:** Iron, zinc, biofortification
DEVELOPMENT OF CASSAVA (MANIHOT ESCULENTA, L.) AND ORANGE FLESH SWEET POTATO (IPOMOEA BATATAS, L.) PRODUCTS: AN APPLICATION FOR BIOFORTIFIED CROPS

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The objective of this study was to evaluate the possibility of the production of food products using biofortified cassava flour (CF) and orange flesh sweet potato flour (OFSP). In order to use new flours for the production of bakery and extruded products, mixtures of different proportions of these flours with wheat flour need to be evaluated to keep the quality of the product. In order to produce pastas using OFSP, the extrusion process was performed in a single screw Pastaia extruder with a fusilli matrix. Afterwards, the pasta was dried in an air circulated oven at 40°C for 1 hour. These pastas and their flours were characterized by particle size, water absorption index (WAI), water solubility index (WSI) and viscosity. In order to observe the substitution limit for the wheat flour (WF) in bakery products, levels of 10%, 15% and 20% of CF were used in breads, and 20% in cakes. These formulations were compared to a standard formulation (100% WF). It could be observed that, according to the extrusion parameters studied, the production of pastas using a biofortified raw material is feasible. The bakery products presented a darker color and a smaller final volume, when compared to the standard loaves. Changes in loaf characteristics were accentuated by the increase of the substitution level; thus, loaves with 10% of substitution were more similar to the standard. In spite of these differences, all the products produced with CF were considered as acceptable for consumption as the standard.

Keywords: Manihot esculenta Crantz, Ipomoea batatas, extrusion, bakery products
**TH32**

“MULTIPLE MICRONUTRIENT SPINKLES USING IRON-FUMARATE IS BETTER THAN USING IRON-NAEDTA IN REDUCING THE RATE OF ANAEMIA AMONG YOUNG CHILDREN IN URBAN SLUM JAKARTA, INDONESIA. A DOUBLE BLIND RANDOMIZED PLACEBO CONTROLLED TRIAL.

S Sunawang, N Sagadi, S Subarkah, M Hasan, S Soekirman

BACKGROUND: Currently about 50% of Indonesian young children still suffer from anaemia. In seeking an effective nation-wide intervention, under the support of grant funding from the JFPR/ADB, Government of Indonesia developed two different formulas of home multiple micronutrient fortification or sprinkles for young children. Each sprinkles contained same 17 vitamins and minerals but the first sprinkles used Iron-NaEDTA and the second sprinkles used Iron-fumarate. An efficacy study was undertaken to assess the impact of consuming the sprinkles in reducing the rate of anaemia.

METHODS: The study design was a double blind, cluster-randomized treatment allocation with placebo controlled intervention in urban slum community setting. The sample size per group was 165, 163 and 169 children of 6-24 months of age respectively for Sprinkles with Iron-NaEDTA, Iron-fumarate and placebo. The exclusion criteria were severe malnourishment below minus 3 Z-score weight for height and severe anaemia with Hb concentration less than 7 g/dL. The intervention was a daily consumption of one sachet sprinkles put into the child’s meal serving for 4 months duration.

RESULTS: The Iron-fumarate group was better than Iron-NaEDTA group in reducing the rate of anaemia after intervention (p=0.012). The Iron-fumarate (RR: 0.48; CI: 0.34-0.67) had better risk reduction of anaemia than Iron-NaEDTA (RR: 0.60; CI: 0.40-1.07). Both were also better than the placebo group (RR: 0.87; CI: 0.70-1.08). However the mean haemoglobin concentration after treatment was not different between Iron-NaEDTA and Iron-fumarate but both were different with placebo (p=0.000 and p=0.001). Iron-NaEDTA showed a trend of declining serum-Z-score weight for height and severe anaemia with Hb concentration less than 7 g/dL. The placebo controlled trial in an urban slum community setting. The sample size per group was 165, 163 and 169 children of 6-24 months of age respectively for Sprinkles with Iron-NaEDTA, Iron-fumarate and placebo. The exclusion criteria were severe malnourishment below minus 3 Z-score weight for height and severe anaemia with Hb concentration less than 7 g/dL. The intervention was a daily consumption of one sachet sprinkles put into the child’s meal serving for 4 months duration.

Conclusion: Multi/micronutrient sprinkles using Iron-fumarate is superior than using Iron-NaEDTA in terms of both reducing the rate of anaemia and the rate of zinc deficiency status after 4 month treatment.

**TH33**

A FORMATIVE STUDY TO ASSESS FACTORS INFLUENCING ADHERENCE, UTILIZATION, AND THE PROMOTION OF SPINKLES AMONG LUO FAMILIES WITH YOUNG CHILDREN IN WESTERN KENYA: THE NYANDO INTEGRATED CHILD HEALTH AND EDUCATION PROJECT (NICHE)

Kethal, Y; Oguya, M; Mwangi, R; Kibe, R; Mburu, P; Luhia, J

Background: A 30-day, 30 household household interview at 2 weeks, and 3 focus group interviews at 4 weeks. Interviews were usually with the primary caregiver of the child and focused on use, perceived benefits, barriers, enabling factors and motivations for purchasing and using Sprinkles. Data were analyzed for recurring themes using NVIVO 7 software.

RESULTS: 24 families with 44 children between m -6 to 59 months of age completed the study. 21 families participated in focus groups. Overall, caregivers described correct knowledge of Sprinkles use and preparation to Sprinkles were easy to use generally well accepted by children, and household members supported use. The most common and important effect reported was increased appetite, usually described as positive; other commonly reported effects included increased immunity, strength, activity levels, and weight. Reduced anaemia was mentioned less frequently. Changes to routines affected adherence, but few reported problems remembering to give the sprinkles or not following instructions. Initial adjustments were reported, but changes to stool color or diarhoea were anticipated and not worrisome. Caregivers reported informally promoting Sprinkles to others, often enthusiastically, and sharing their sachets with family and friends. They also anticipated purchasing Sprinkles in the future. Caregivers reported potential barriers to Sprinkles use included cost, availability, and lack of knowledge or experience with Sprinkles.

Conclusions: Instruction on proper use and possible changes to stool color and diarrhoea are important to support adherence and utilization. Caregivers perceived improved appetite, immunity and strength as the most important and compelling benefits, and these should be considered in future promotions. Caregiver informal promotion to family and friends may be an important way to raise awareness and promote adherence and utilization.

**TH34**

FLEXIBLY ADMINISTERED LOW DOSE SPINKLES INTERVENTION FOR PREVENTION OF ANAEMIA IN CHILDREN – AN EFFECTIVENESS PROGRAM IN RURAL / URBAN MAHARASHTRA, INDIA

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Background: Anaemia prevalence continues to be high (60 to 90%) in children in India. Iron supplementation programs have failed due to poor compliance or failure to reach the most vulnerable populations. Home fortification of foods with 'Sprinkles' is an innovative strategy to deliver iron and other micronutrients to young children. Single serving sachets of 'Sprinkles' over cooked food does not alter its color, taste or smell. Low-dose Sprinkles are well tolerated and efficacious in treating anaemia in young children (Dave S, 2007). Sixty sachets of sprinkles contain 150 mg iron over 90 days (Sprinkles) as effective as daily schedule in reducing anaemia (H CPUs 2007). Aims: To test the effectiveness of flexible administration of Sprinkles delivered through existing Integrated Child Development Scheme (ICDS) in Maharashtra State-an reducing the prevalence of anemia in children aged 6 months to 6 years.

Methods: A total of 17126 children (6 m-o - 6 yr age) from 4 rural and 1 urban slum ICDS blocks were administered sprinkles at the anganwadi. Mean compliance (expressed as % of sprinkles sachets consumed / % * 100) reported by ICDS workers ranged from 96% to 100% among non-fortified group and approximately 98% for home based administration. The endline survey however estimates the overall compliance to be above 95% for home based administration. 3-months of 6 children consumed 60 sachets while 91% consumed less than 40 sachets. Overall, anaemia prevalence among children aged 6 months to 6 years dropped significantly (p-value<0.001) from 58.5% at baseline to 33.3% post-intervention, the improvement seen more in urban slum children after controlling for age and sex of the child.

Results: Low-dose Sprinkles flexibly administered through an anemia prevention/ control program is highly effective in reducing anaemia in young children.

**TH35**

LESSONS LEARNT FROM INTEGRATING A MULTIPLE MICRONUTRIENT POWDER (VITASHAKTI) INTO A FEEDING PROGRAMME FOR VULNERABLE GROUPS.

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Background: In India 70% of children aged 6-36 months and 55% of women are affected by anemia and vitamin A deficiency prevalence ranges from 26 to 80%. Corrective action through health service-based programs is possible, but limited by sub-optimal coverage and compliance (NRIS 2008). The daily distribution of food supplements providing 30 kcal and 2 mg of iron (as ‘khichdi’ (a rice and lentil mixture) to poorer children through the Integrated Child Development Service (ICDS) offers an opportunity to intervene to improve nutritional status of these children. Aim: To determine the efficacy and feasibility of distributing a multiple micronutrient powder (Vitashakti) containing iron, folic acid and vitamin A to children served by the ICDS.

Methods: A double-blind, cluster randomized trial was conducted with 30 participating village centers in South 24 Parganas district of West Bengal. Village centers were randomly assigned to receive either fortified or non-fortified khichdi. 516 children aged 36 to 66 months attending the centers were enrolled. Measurements of height, weight, hemoglobin, serum ferritin, retinol and C-reactive protein were conducted using standardized methodologies before and after 24 weeks of intervention. ICDS staff were trained in the storage of premix and preparation of fortified khichdi.

RESULTS: 86.9% children consumed 100% of the khichdi provided, indicating high compliance. Hemoglobin and serum ferritin concentrations in anemic children were significantly increased (P<0.001) in the fortified group from weeks 0 to 24 and after 24 wks respectively. The prevalence of anemia, iron deficiency and iron deficiency anemia were significantly lower after 24 wk in the fortified group (P<0.001), with a continued reduction trend in anemia in the fortified group, while prevalence in the non-fortified group increased between weeks 12 to 24. The decrease in the prevalence of iron deficiency was significant in the fortified group as compared to non-fortified group after the 24 wk intervention. The prevalence of iron deficiency anemia was nearly eliminated in the fortified group, while remaining unchanged in the non-fortified group. There was no significant difference in the prevalence of vitamin A deficiency between the two groups.

Conclusions: The results indicate both the feasibility and potential effectiveness of integrating ‘Vitashakti’ into an existing large scale feeding program (e.g. ICDS) to reduce iron deficiency in participating children at a cost of 3 cents per child per year. Based on these results the program has since been scaled up from 0.72 to 0.49 million in West Bengal. Vitashakti has also been trialed successfully in camps for internally displaced people in Darfur Sudan where it has been trialled successfully in camps for internally displaced people in Darfur Sudan where it...
EvidEncE-basEd Programs

Micronutrients, HealTh and development:
EvidEncE-basEd Programs

TH36
MONITORING ACCEPTABILITY AND KNOWLEDGE OF SPRINKLES AMONG LUO FAMILIES IN WESTERN KENYA: NYANDO INTEGRATED CHILD HEALTH AND EDUCATION PROJECT (NICHE)

Methods: A cross-sectional representative survey with 498 mothers or fathers of young children; mothers targeted by Sprinkles use (high/low/started-stopped); also included 21 focus group and 34 key informant interviews using purposeful sampling of mothers and fathers, and village level leaders.

Background: The Safe Water and AIDS Project (SWAP) combined social marketing with mobilization of local institutions to promote the sale of Sprinkles. Community members received information on preparation, appropriate use, and potential effects. Children 6-59 months were to consume <1 sachet/day.

Aim: Describe acceptability and knowledge of Sprinkles among community members in 10 intervention villages.

Methods: Qualitative monitoring of acceptability and knowledge started in August 2007. It included 21 focus group and 34 key informant interviews using purposeful sampling of mothers or fathers of young children; mothers targeted by Sprinkles use (high/low/started-stopped); and general adult population. A cross-sectional representative survey with 498 mothers (child 18-47 months) in March 2008 measured acceptability and knowledge 10 months after implementation.

Results: Qualitative data were analyzed for recurring themes; quantitative analysis calculated frequencies.

Results: In qualitative interviews over 10 months, participants continually reported adult and child acceptability was good, and most perceived positive effects of increased appetite, improved general health and decreased disease. When asked about acceptability by other family or friends, the 2 most common responses they supported use, or were unaware of use. When asked to describe the worst thing about Sprinkles, most reported none, a few said loose/dark stool or cost, and very few referred to rumors (e.g., infertility). Almost all current users said they expected to continue, while most who stopped said they plan to use again. Most common reasons for stopping were lack of ready use (e.g., vomiting) or non-Sprinkles related illness. Never/rarely users said observing positive effects in others and receiving more information would motivate use. From the survey, most knew of Sprinkles (98%), and described it positively (96%) with pricing affordable for all (96%). Most described it as a vitamin/mineral powder (41%), drug (29%), or food supplement (16%). 61% said it was for children 6-59 months; 83% said dosage was 1 sachet/day. Most common perceived barriers to use were lack of information (34%), cost (27%), causing loose stool (12%) and lazy/forgetful parents (11%).

Conclusions: Overall, monitoring shows Sprinkles have continually had a positive reputation with good acceptability and knowledge. Barriers focused more on lack of information, cost, and motivation versus qualities of the product itself; the intervention staff focused efforts strategically in these areas to increase use through additional trainings and promotions in communities.

TH37
MONITORING OF SPRINKLES PROMOTIONAL STRATEGIES IN WESTERN KENYA: THE NYANDO INTEGRATED CHILD HEALTH AND EDUCATION PROJECT (NICHE)

L Radh, M Jezzineh, A Obure, C McRae, P Suchdev, P Sudharsan

Background: The Safe Water and AIDS Project (SWAP) combined social marketing with mobilization of local institutions to promote the sale of Sprinkles by vendors in 30 intervention villages. To develop promotion strategies, formative research and testing of materials/messages were conducted with families. Promotion began June 2007 and included training of vendor groups and village leaders; community promotional launches; marketing materials and consumer incentives (e.g., calendars); vendor sales incentives (e.g., t-shirt); and ongoing visits by field officers.

Aim: To assess implementation and monitoring of promotional strategies for this intervention.

Methods: Quantitative and qualitative data collection is ongoing for promotional strategies since February 2007. Office records monitor distribution of incentives and promotions. A March 2008 representative cross-sectional survey of 498 mothers with children 18-47 months measured exposure to promotions. Qualitative data included 28 observations of initial vendor trainings and community promotional launches, 28 key informant interviews with high/low selling vendors and 14 focus groups with families with young children. Quantitative data were analyzed by frequencies. Qualitative data were analyzed for recurring themes.

Results: 14 vendor groups (50-113 vendors, 75% women) received training, and 14 Sprinkles promotional launches introduced villages to Sprinkles (≤198 adults/launch, 75% female). Survey findings show that mothers heard about Sprinkles through vendors (47%) and launches (28%); 69% received calendars and 49% caps. Qualitative data shows 1) interpersonal promotion of Sprinkles occurs formally and informally by vendors and among the population; and 2) consumer and vendor incentives motivate sales. Vendors reported formal training was important in order to promote Sprinkles and that untrained vendors communicated incorrect information. Families reported that informal promotion or discouragement occurs among families and friends, and testimonials of positive experiences can be powerful motivators. Vendors reported consumer incentives motivated sales but were less effective through time, and vendor sales incentives are critical to keep vendors motivated. Vendors often reported changing or not following consumer incentive guidelines to gain sales.

Conclusions: Quality trainings and launches, repeated periodically with wide access, are necessary for promotion by vendors and community members. Incentives valued by vendors and consumers are important. Monitoring informs the success/limits of promotions and is critical for effective strategic planning.

TH38
EFFECT OF COMPLAN SUPPLEMENTATION ON THE GROWTH COGNITIVE AND HAEMOGLOBIN PROFILE OF CHILDREN

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Study the existing nutritional status of 7-12 year old children, and nutritional deficiencies among them lead to a generation of nutritionally high-risk population perpetuating a next generation with stunted growth, poor cognitive and physical development. This startling fact makes it a silent emergency warranting urgent measures to prevent intergenerational perpetuation of malnutrition.

Aim: Study the existing nutritional status of 7-12 year old children, supplement their diets with complan and evaluate the effect of supplementation.

Methods: A total of 900 children with similar socio-economic background, food intake and anthropometric measurements: were selected, of whom 300 formed experimental group (receiving 60g of complan and 300ml of toned milk), another 300 formed the experimental group II receiving 60g of complan in 300ml of water and another 300 children serving as group III (control). Feeding went on for one year. The effect of supplementation was assessed through anthropometric (every month), biochemical, physical, cognitive and clinical assessments, which were done initially, as well as at the end.

Results: The food and nutrient intakes were inadequate in all the three groups, deficit of energy, protein and calcium being around 30% and a glaring deficit in most of the micronutrients. Supplementation bridged the gap to a great extent. Initial mean heights and weights were similar and below standard among all the three groups. Supplementation resulted in 7-8.4cm growth among boys in group I, 5.6-7.1cm in group II and 2.7-3.4cm in control, while that of girls ranged from 3.7-4.3 cm, 6.0-7.1cm and 2.8-3.6cm respectively. The mean increments in weight for boys was 4.58-5.4 kg (I), 2.75-4.47 kg (II), 1.66 to 2.52 kg (III) and for girls weight increments were 4.38-5.61 kg, 2.97-4.7 kg and 1.95-3.28 kg respectively. Supply of complan resulted in greater height and weight increments and had wiped off third degree morbidity completely, favourable changes observed in the clinical picture, memory, concentration attention and intelligence. The haemoglobin values had increased from 8.61 to 10.00g, 8.66 to 9.16g and 8.53 to 9.15g /dl respectively. The findings of this study has thrown light on the extent to which complan supplementation can stimulate growth, cognition, physical performance and haemoglobin levels among children in the crucial stage of their growth.

Conclusions: Present findings call for creating awareness among people regarding the advantage of including complan in the diets of children.

ABSTRACTS

Thursday, 14 May, 2009

Scaling-up New Technologies: Micronutrient Powders, Spreads, Home-based Fortification

MICRONUTRIENTS, HEALTH AND DEVELOPMENT:
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TH39
IRON ABSORPTION OF FROM HOMEMADE COMPLEMENTARY FOOD FORTIFIED WITH FERROUS SULPHATE AND SODIUM IRON EDTA IN CHINESE CHILDREN

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Background: According to the Chinese Nutrition and Health Survey 2002, circa 30% of young children are anaemic, mainly due to iron deficiency. Food fortification with micronutrients as a cost-effective and sustainable strategy is currently being evaluated in China and other Asian countries. However, young children do often not consume enough of the fortified products such as soy sauce. Therefore in-home fortification of complementary foods should be considered to improve the micronutrient status of young children.

Aims: To determine whether Sprinkles and/or syrup should be suggested for use by the program.

Methods: The complementary food chosen for the study, i.e. millet porridge and dumplings with cabbage and tofu, was identified in a dietary assessment of a commonly consumed food in a rural community in Yuanshi County, China. The complementary foods were fortified with either 2 mg ferrous sulphate or sodium iron EDTA (study 1) or 4 mg ferrous sulphate or a mixture of ferrous sulphate/sodium iron EDTA (study 2) and administered to the children under close supervision. The iron was labeled with iron stable isotopes by evaporation incorporation of iron stable isotopes 14 days after oral administration. Fourteen children aged 2-2.5 years completed study 1, 15 children of the same age completed study 2.

Results: Geometric mean (±SD) iron absorption from the fortified complementary food varied between 4 mg Fe equally from FeSO4 and NaFeEDTA/FeSO4.

Study 1: Absorption (%) Absorption ratio (paired t-test)
2 mg Fe as FeSO4 8.0 (1.1, 20.3) 1.15 0.19
2 mg Fe as NaFeEDTA 9.3 (1.1, 27.0) 1.15 0.19

Study 2: Absorption (%) Absorption ratio (paired t-test)
4 mg Fe as FeSO4 4.3 (1.9, 8.9) 0.99 0.99
4 mg Fe as NaFeEDTA 6.4 (3.0, 13.5) 1.56 0.01

Conclusions: No significant difference was found between the iron absorption from FeSO4 and NaFeEDTA at a fortification level of 2 mg. At the higher fortification level of 4 mg a significant difference was found between FeSO4 to FeSO4/NaFeEDTA. In this study the combination of FeSO4 and NaFeEDTA at a fortification level of 4 mg per meal was shown to lead to the highest amount of iron absorbed from the tested complementary food.

The financial support of the International Atomic Energy Agency is gratefully acknowledged.

TH40
SPRINKLES AND SYRUP CONFER THE SAME BENEFITS IN ACTIVITY AND EXPLORATION AS DOES THE FORTIFIED-FOOD SUPPLEMENT CURRENTLY PROVIDED BY THE MEXICAN POVERTY-ALLEVIATION PROGRAM OPORTUNIDADES: RESULTS FROM A RANDOMIZED TRIAL

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Background: The Mexican government sponsors a national poverty-alleviation program, Oportunidades, which provides a fortified-food supplement, Nutrisano, to all children less than 2 years of age in beneficiary families. Nutrisano provides iron, zinc, vitamin A,C,E,B12, folic acid, and energy (carbohydrate, fat and protein). The lack of wasting (< 2%) and the high rates of overweight in Mexico, even in the economically disadvantaged, put in question the need for the energy supplied by Nutrisano.

Aims: To compare the impact of Nutrisano (MME) to Sprinkles and micronutrient syrup, both having an identical micronutrient profile as Nutrisano but not energy, on physical activity and exploration in children.

Methods: In a sample of 169 beneficiary children 6–12 months of age at baseline, we measured height, weight, Hb concentration, motor development, and physical activity and exploration at baseline and after 4 months of supplementation with Nutrisano, Sprinkles, or syrup. We measured activity and exploration by direct observation during 15 minutes of individual play in a novel environment and generated 3 activity and 2 exploration clusters using two separate cluster analyses based on 6 activity and 5 exploration variables. We used logistic regression to test the effect of the MME relative to Sprinkles and syrup, and relative to Sprinkles and syrup combined (MM) on inclusion in the higher activity or exploration cluster.

Results: There was no effect difference between Sprinkles and syrup on either outcome (p > 0.05). There was a tendency for children receiving MME to have lower odds of being in the high activity cluster relative to those receiving MM (OR = 0.48, p = 0.10). Anaemia at baseline modified the effect of MME relative to Sprinkles and syrup, and relative to Sprinkles and syrup combined (MM) on inclusion in the higher activity or exploration cluster.

Conclusions: After 4 months of supplementation, Nutrisano did not confer additional benefits on activity and exploration compared to those provided by Sprinkles and syrup having an identical micronutrient profile but not energy. The impact of Sprinkles on activity and exploration was not different than that of syrup. Additional outcomes including acceptance and cost will be assessed to determine whether Sprinkles and/or syrup should be suggested for use by the program.
TH41 EFFECTIVENESS OF SPINKLES SALES IN WESTERN KENYA IN REDUCING CHILDHOOD ANEMIA AND IRON DEFICIENCY: THE NYANDO INTEGRATED CHILD HEALTH AND EDUCATION PROJECT (NICHE)

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Background: In March 2007, CDC joined with partners to implement the Nyando Integrated Child Health and Education Project (NICHE), an effectiveness study that combines social marketing with mobilization of local institutions to promote the sale of Sprinkles along with other health products. Children 6-59 months were instructed to consume <1 sachet a day.

Aim: To measure the impact of Sprinkles sales on anemia and iron deficiency among children in the project area.

Method: We randomly selected 60 villages from Nyando Division (population 60,000) and allocated them into intervention and comparison groups. In intervention villages, Sprinkles are distributed by vendors who sell health products to neighbors. In comparison communities, Sprinkles are not promoted nor marketed by this network. Biweekly household visits measured Sprinkles use. Representative cross-sectional surveys collected blood and anthropology at baseline (n=1,066 children 6-35 months) and at 12 months follow-up (n=855 children 18-47 months). Prevalence of anemia was compared between and within groups using Chi-square analysis. Linear regression models measured change in hemoglobin by Sprinkles consumption, adjusting for age and sex. Data were analyzed accounting for cluster sampling.

Results: The change in anemia prevalence by intervention and comparison group is presented below:

<table>
<thead>
<tr>
<th>% Anemia (95% CI)</th>
<th>Intervention</th>
<th>Comparison</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>64.6 (60.4-68.6)</td>
<td>66.9 (62.5-71.0)</td>
<td>0.50</td>
</tr>
<tr>
<td>12-month follow-up</td>
<td>39.1 (34.6-43.9)</td>
<td>47.2 (42.3-52.2)</td>
<td>0.02</td>
</tr>
<tr>
<td>p-value within group</td>
<td>&lt;0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference (%) in anemia</td>
<td>25.5</td>
<td>19.7</td>
<td></td>
</tr>
</tbody>
</table>

Average intake was 1.2 sachets per week among children from households in intervention villages reporting purchase of Sprinkles. Regression analysis showed a significant positive association between the number of sachets purchased by households and final hemoglobin (p=0.04). There was also a 3.5% decrease in iron deficiency among children in intervention households (p=0.04). No change in the prevalence of malaria, wasting, or stunting was observed.

Conclusions: Sprinkles household-based distribution through community vendors is effective in reducing anemia and iron deficiency in a resource poor-setting and endemic malaria area. NICHE will also assess the long-term effectiveness of Sprinkles distribution in this setting.

TH42 SPRINKLES USE NOT ASSOCIATED WITH MORBIDITY AMONG YOUNG CHILDREN IN WESTERN KENYA: THE NYANDO INTEGRATED CHILD HEALTH AND EDUCATION PROJECT (NICHE)

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Background: Treatment of iron deficiency with home-fortification, such as Sprinkles, is efficacious and cost-effective. However, the safety of Sprinkles use in malaria-endemic areas has not been established. As part of the Nyando Integrated Child Health and Education Project (NICHE), Sprinkles are sold to women’s groups with monitoring of coverage and biological impact. Children 6-59 months are instructed to consume not more than one sachet per day.

Aim: To measure morbidity associated with Sprinkles use among children in the NICHE project.

Methods: A cohort of children aged 6-59 months, data from baseline and follow-up cross-sectional surveys, and from biweekly household surveillance visits during 12 months were analyzed using logistic regression to assess the association between Sprinkles use and morbidity. Sprinkles use was measured at each surveillance visit and defined as any reported household purchase across the study period. Morbidity was reported by the household respondent and defined as either hospital or clinic visits for malaria in the previous two weeks, or fewer in the 24 hours preceding the surveillance visit. Models were adjusted for age, sex, socio-economic status, and residence in intervention or comparison village. We also tested for interaction between Sprinkles use and anemic status at baseline, since non-anemic children may be at increased risk for malaria with iron use. Logistic models were analyzed using generalized estimating equations to account for correlations in repeated measures.

Results: Of the 996 children followed in intervention and comparison villages (14,511 observations), 12.7% reported at least one hospital or clinic visit for malaria, 80.4% reported at least one episode of fever, and 66.5% came from households that purchased Sprinkles sachets (median = 1.6 [range 0.06-15] sachets purchased per 2 weeks). Sprinkles use was not associated with hospital or clinic visits for malaria (OR=0.95, CI=0.61-1.49) and malaria incidence at baseline (OR=0.67, CI=0.41-1.02), and there was no difference in hospital or clinic visits for malaria by baseline anemia status (non-anemic OR=0.54, CI=0.29-0.98; anemic OR=0.70, CI=0.48-1.03). Results were similar using reported fever as the morbidity outcome (OR=0.89, CI=0.76-1.05, for interaction: 0.45).

Conclusions: Although NICHE was not designed to look specifically at adverse events, preliminary data indicate that Sprinkles use was not associated with a measurable increase in hospitalization or clinic visits due to malaria or reports of fever. Ongoing longitudinal monitoring of Sprinkles use and morbidity will further assess the safety and effectiveness of Sprinkles.

TH43 EFFECTIVENESS OF COMMUNITY LEVEL FORTIFICATION OF SCHOOL LUNCH MEALS IN INDIA

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This study determined the effectiveness of micronutrient fortification of school meals cooked and fortified at the school on anemia and micronutrient status of schoolchildren in Himachal Pradesh, India. The study was a cluster randomized controlled trial in which 499 schoolchildren (6-10y) received either a micronutrient treatment group or placebo (control group) as part of their school meals (60 kcal) for 8 months. The micronutrient formula provided 60 mg iron, 375 µg vitamin A, 2.4 mg zinc, 225 mg folate acid and 3.5 mg vitamin B12 for each child per day (~75% RDA). Blood samples drawn before and after the intervention were analyzed for hemoglobin and serum ferritin, retinol, zinc, folate and vitamin B12.

Baseline prevalences of anemia, iron deficiency anemia and low serum concentrations of ferritin, retinol, zinc, folate and vitamin B12 were 16.2%, 10.2%, 24.1%, 56.1%, 74.9%, 67.9% and 5.7% respectively, with no significant differences between groups. At the end of the intervention, the treatment group was less likely to have low serum ferritin (OR [95% CI]: 0.57 [0.33-0.97]) and low serum folate (OR [95% CI]: 0.47 [0.26-0.84]) compared to the control group. Vitamin B12 significantly increased in both groups, but the magnitude of change was less in the treatment compared to the control group (p=0.05). School-level micronutrient fortification of school meals was effective in improving folate and serum retinol status and reduced the magnitude of seasonal decrease in vitamin B-12 status. It also has potential for improving body iron status.
EVIDENCE-BASED PROGRAMS

TH44 SCALE UP SPRINKLES SUPPLEMENTATION FROM PILOT PROJECT TO DISTRICT – WIDE IMPLEMENTATION

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UNICEF Indonesia working together with MoH in introducing sprinkles supplementation to children age 6-59 months in larger scale. Through Community Health and Nutrition System Strengthening (CHANSYS) Project, sprinkles introduced in 2 pilot districts (Sikka and Lombok Tengah). First stage of sprinkles distribution, covering around 25-30% children in each districts. Strategy in distributing sprinkles for the first time was using momentum of Vitamin A month in August 2007, that usually the coverage are high. We were able to distribute 90 sachets sprinkles to 27,661 children in Lombok Tengah and 11,818 in Sikka. The total amount was projected for 6 months supplies. In February 2008, we agreed to adjust 6 months supplies distribution into one or two months redistribution. Main reason is to increase coverage and answers doubts/questions/difficulties on consuming sprinkles. We are in the process of evaluating sprinkles distribution after one year intervention, looking how health system adopting sprinkles intervention, behavior change in child feeding, and impact on child's nutrition practices.

Next October and April 2009, UNICEF and MoH is going to conduct Hemoglobin study to sprinkles and non sprinkles children. Sikka as an malaria endemic, we going to have joint study on sprinkles impact on children Nutrition and malaria. Starting February 2009, CHANSYS project is going to scale up the sprinkles distribution to all children in Sikka district and 80% children in Lombok Tengah. Total number of children that will receive sprinkles will be around 70,000.

TH46 PROSPECTIVE COHORT STUDY TO TEST THE EFFICACY OF ‘SPRINKLES’ IN CONTROLLING ANEMIA AMONG YOUNG CHILDREN IN KYRGYZSTAN

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Background: Iron deficiency anemia is widespread among children in Kyrgyzstan. The 1997 DHS in Kyrgyzstan found that 50% of children under the age of three have anemia. A percent Sprinkles sachets to use daily for 2 months. A questionnaire on diet, overall health, compliance, and side effects was administered at baseline and follow-up. From the 2,283 children screened at baseline, 1,834 were eligible for the study and available for Hb measurement at baseline and follow-up (932-intervention; 902-control). Results: Sprinkles reduced the prevalence of anemia. In the intervention group, the mean Hb increased (100.1 to 102.8 g/L), and the percentage of anemic children (Hb<110 g/L) decreased (71.9% to 52.0%). In the control group, the mean Hb decreased (98.6 to 96.1 g/L), and the percentage of anemic children remained high (71.8% to 74.9%). In follow-up, there was a significant difference between the control and intervention groups in mean Hb (p<0.00) and anemia prevalence (p<0.00). Compliance was high (on average 75%). Conclusions: A 28% relative reduction in anemia prevalence in intervention children was achieved within the 2-month period. These results demonstrate that 60 Sprinkles sachets taken daily for 2 months can reduce the prevalence of anemia among young children in Kyrgyzstan. The study provided evidence that Sprinkles can be an effective intervention within a national anemia control strategy, which is currently being developed. As a part of the national anemia control strategy, a pilot intervention with Sprinkles is presently being planned.

TH45 COMBATING ANAEMIA AND MICRONUTRIENT DEFICIENCIES AMONG YOUNG CHILDREN IN RURAL CAMBODIA THROUGH HOME-FORTIFICATION AND NUTRITION EDUCATION. (GOOD FOOD FOR CHILDREN STUDY)

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Background: Many children in rural Cambodia suffer from iron and zinc deficiencies. As a result of the Community Health and Nutrition System Strengthening (CHANSYS) Project, a micronutrient supplementation program was introduced to eight districts in Cambodia. Results: By testing the effectiveness of delivering Sprinkles and IYCF education through existing operational health district with 20 health centres (approximately 3600 infants) to receive daily sprinkles sachets (each with 12.5 mg iron) and weekly IYCF education. In the intervention group were not due to the intervention. The disappointing results prompted a 28% relative reduction in anemia prevalence among intervention children was achieved within the 2-month period. These results demonstrate that 60 Sprinkles sachets taken daily for 2 months can reduce the prevalence of anemia among young children in Kyrgyzstan. The study provided evidence that Sprinkles can be an effective intervention within a national anemia control strategy, which is currently being developed. As a part of the national anemia control strategy, a pilot intervention with Sprinkles is presently being planned.

TH47 PROGRAM EVALUATION STUDY TO DETERMINE THE EFFECTIVENESS OF WEEKLY ‘SPRINKLES’ ADMINISTRATION IN CONTROLLING ANEMIA AMONG YOUNG CHILDREN IN KYRGYZSTAN

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Kyrgyz-Swiss-Swedish Health Project (funded by Swiss Agency for Development and Cooperation and the Swedish International Development Cooperation Agency) and implemented by the Swiss Red Cross), Bishkek, Kyrgyzstan, 1Hospital for Sick Children, Toronto, Canada

Background: Iron deficiency anemia is widespread among children in Kyrgyzstan. The 1997 DHS in Kyrgyzstan found that 50% of children under the age of three have anemia. A percent Sprinkles sachets to use daily for 2 months. A questionnaire on diet, overall health, compliance, and side effects was administered at baseline and follow-up. From the 2,283 children screened at baseline, 1,834 were eligible for the study and available for Hb measurement at baseline and follow-up (932-intervention; 902-control). Results: Sprinkles reduced the prevalence of anemia. In the intervention group, the mean Hb increased (100.1 to 102.8 g/L), and the percentage of anemic children (Hb<110 g/L) decreased (71.9% to 52.0%). In the control group, the mean Hb decreased (98.6 to 96.1 g/L), and the percentage of anemic children remained high (71.8% to 74.9%). In follow-up, there was a significant difference between the control and intervention groups in mean Hb (p<0.00) and anemia prevalence (p<0.00). Compliance was high (on average 75%). Conclusions: A 28% relative reduction in anemia prevalence in intervention children was achieved within the 2-month period. These results demonstrate that 60 Sprinkles sachets taken daily for 2 months can reduce the prevalence of anemia among young children in Kyrgyzstan. The study provided evidence that Sprinkles can be an effective intervention within a national anemia control strategy, which is currently being developed. As a part of the national anemia control strategy, a pilot intervention with Sprinkles is presently being planned.

Aim: To test the operational feasibility of delivering multi-micronutrient ‘Sprinkles’ with nutrition education through existing government health services linked to the community in order to inform policy and nationwide programs to address under-nutrition.

Methods: Cluster randomized effectiveness study recruiting all infants aged 6-24 months from one operational health district with 20 health centers (approximately 1000 infants) to receive daily micronutrient home fortification (Sprinkles), and infant and young child feeding (IYCF) education versus IYCF education alone for 6 months, implemented through existing Government health services linked to the community. A sub-sample of 1200 infants monitored at age 6 mo, 12 mo and followed up at 18 mo for biochemical assessment of anemia and iron, vitamin A and zinc deficiencies, growth and feeding practices.

Implications: By testing the effectiveness of delivering Sprinkles and IYCF education through existing systems, realistic policies and scale-up plans can be formulated to address the huge problem of anaemia and other micronutrient deficiencies among infants and young children in Cambodia.

Conclusions: The National Nutrition Program (MoH, Cambodia) is capable implementing the delivery of Sprinkles and infant and young child feeding education in one operational health district in rural Cambodia. If this intervention is effective in combating anaemia and other micronutrient deficiencies and improving growth, there will be plans to scale it up nationwide.

Funded by: USAID, A2Z Cambodia; Health Sector Support Project, World Bank Cambodia; World Health Organization Cambodia
**TH48**

**SIGNIFICANT DOSE-RESPONSE OF SUPPLEMENTATION WITH MICRONUTRIENT SYRUP A FOR FORAGED FOOD OR SPRINKLES ON CHILD LENGTH AT 24 MO OF AGE IN MEXICAN CHILDREN**

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**Background:** Opportunidades, a conditional cash transfer program with over 5 million beneficiary families in Mexico distributes a fortified milk-based complementary food (Nutrisano) to children 6 to 23 mo of age. Although the program has had a significant impact on child growth, the prevalence of anaemia, micronutrient deficiency and growth faltering remain high in the population. Other supplements might be as effective and less expensive.

**Aim:** To monitor adherence and coverage to help justify a scale-up of the program to a wider population.

**Methods:** To carry out the monitoring plan for the Sprinkles program, MoH identified persons to perform regular visits to health centers, developed a schedule for supervision, designed monitoring instruments to measure coverage indicators, and supported a study on mothers’ adherence to the fortification directives. The monitoring protocol included logistical surveillance of the supply of Sprinkles, revision of forms to register Sprinkles distribution, supervision of the counseling given in health centers, the display of monitoring data in each health center, and visits to households to directly monitor usage. Lastly, technical meetings were held on a monthly basis at local and central levels, to assess implementation progress, disseminate coverage data and discuss obstacles and limitations.

**Results:** The MoH monitoring protocol indicated coverage from 86 to 94% of children aged 6 to 59 months, with 84% of those receiving Sprinkles adhering to the directives.

**Conclusions:** A number of factors are thought likely to have contributed to these positive results. Firstly, engaging MoH staff in the design and implementation of the program, protocols and instruments helped to ensure political will at central level and the dedication of health center staff at local level. Secondly, involvement of the field staff and provision of the necessary resources needed to carry out visits encouraged the commitment of health center staff lastly, planning of monthly technical meetings proved essential to ensure regular monitoring of coverage data and disseminate lessons learned in a timely manner. The pilot program in three health districts has since been expanded to include all health districts in Alta Verapaz, to benefit a total of 119,044 children under 5 years.

**TH51**

**EVALUATING ACCEPTABILITY OF HOME BASED FORTIFICATION APPROACH FOR DELIVERY OF ZINC AND IRON IN CHILDREN AGED 6-24 MONTHS**

P. Dhingra1,2, S. Sazawal1, U. Dhingra1, V. Iyengar3, V. Menon2, A. Sarkar2, R. Black1

**Background:** In peri-urban settlement of New Delhi, 796 children aged 6-24 months with no major illnesses and consuming complementary foods in addition to breast milk were randomly allocated to receive either fortified powdered added to regular food (FF = 265) or one of three varieties of pre-fortified weaning food (prepared with water) (Tajri (TJ) = 265, Roasted Rice (RR) = 132) once daily for 15 days. Home visitation was undertaken twice a week and at the end of study to gather information on overall acceptance of these approaches.

**Results:** More than half of children in the age group of 1-4 years in the developing world have zinc and iron deficiencies which predispose them to infectious diseases, anemia, impaired growth and development. Sustainable approaches to combat these deficiencies are public health priority. Given the failure of supplementation programs, home based fortification of iron/zinc may be an effective alternative strategy for delivery of these micronutrients. Acceptability of this concept by mothers is a key determinant for successful implementation of such a program.

**Aim:** To evaluate the parent and child acceptability of two home based food fortification approaches.  

**Methods:** In peri-urban settlement of New Delhi, 796 children aged 6-24 months with no major illnesses and consuming complementary foods in addition to breast milk were randomly allocated to receive either fortified powdered added to regular food (FF = 265) or one of three varieties of pre-fortified weaning food (prepared with water) (Tajri (TJ) = 265, Roasted Rice (RR) = 132) once daily for 15 days. Home visitation was undertaken twice a week and at the end of study to gather information on overall acceptance of these approaches.

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TH52

FORMATIVE RESEARCH ON ZINC TREATMENT AS AN ADJUNCT THERAPY FOR CHILDHOOD DIARRHEAL ILLNESS

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BACKGROUND: The government of India has adopted a policy to zinc supplementation in treatment of diarrhoea, on pilot basis, in selected districts of the country, amongst children below five years of age. The prevalence of zinc deficiency in children from different regions of the country was: lacking hence present community based, cross-sectional study conducted in 5 states namely - Uttar Pradesh (Northern), Karnataka (Southern), Orissa (Eastern), Gujarat (Western) and Madhya Pradesh (Central) regions. The study data was collected between January 2006 and April 2007. The sample size was calculated considering the prevalence of zinc deficiency in children as 40%, the relative precision of 10% and 95% confidence level was considered. The sample size of 300 children per State was calculated. In each state, one district was selected randomly and in the selected district, all the ICDS projects were enlisted and one project was randomly selected from the project. In total, 1655 children of age group of 6-60 months were covered. A total of 1655 children (856 males and 819 females) in the age group of 6-60 months were covered. The data was collected on age, sex, socio-demographic profile, breast feeding and infant feeding practices; the dietary habit of the family, current and past morbidity status of each child. Anthropometric measurements of weight and height were undertaken. The blood sample of each child was collected for the estimation of its serum zinc, and CDF test. The standard Methods were used for collection, processing and storage of blood samples. A total of 1655 children were covered: Gujarat (353), Karnataka (356), M.P (303), Orissa (445) and UP (316). The mean age of the subjects was 35.24 months ± 15.47 years. The cut-off used for zinc deficiency was 6.05 mg/d. The prevalence of zinc deficiency found was to be Gujarat, Karnataka, M.P, Orissa and UP which was found to be 64.2, 16.2, 18.9, 33.4 and 68.1 percent. It was found that 34.2% of the children who were zinc-deficient were stunted, 17.5% were wasted and 48.3% were underweight. Results: Multiple regression analysis showed that state, caste, roots & tabies and sugar & jaggery were significantly associated with zinc deficiency. Study documented high prevalence of zinc deficiency amongst children in the 5 states studied. The zinc supplementation can be undertaken along with ORS for treatment of diarrhoea the entire country as it is high deficiency exists.

TH53

THE IMPACT OF FEEDING CORN-SOY BLEND ON SERUM ZINC OF 6-9 YEARS OLDS, SUBA DISTRICT, KENYA

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BACKGROUND: This project was carried out in Suba district of Kenya where the HIV prevalence is 33 percent – one of the highest in Kenya. The high prevalence is exacerbated with poverty and malnutrition.

AIMS: The objective was to determine the effect of corn soy supplementation on serum zinc levels among primary school pupils in Suba District. This was necessary as the district had one of the highest HIV levels in the country and zinc was implicated in the progression of HIV to AIDS. In the presence of good zinc levels HIV progression to AIDS and death is slowed down. It was hypothesised that corn-soy blend contained enough zinc levels to reduce the rate at which HIV progresses to AIDS and give a better quality of life to people living with HIV and AIDS.

METHODS: Three primary schools took part in the experiment. Two schools were fed corn-soy blend while one school was not fed. Assessment of blood serum zinc levels were carried out using data drawn from 156 school children at baseline and 138 school children at follow up (after feeding). Blood samples were wrapped in foil, centrifuged at 3,000 revolutions and stored in liquid nitrogen at -70°C for onward transportation to the analysis centre. The WHO precautions and guidelines for drawing blood were followed. SPSS and Mini tab survey packages were used to analyze data into descriptive and inferential statistics.

RESULTS: At baseline, nearly all (95.7%) the pupils were with low serum zinc (<10.7µm/l). There was a significant reduction (p=0.042) to 70.2% after a 3 month corn soy blend feeding trial. The mean serum zinc improved from 8.4µm/l to 10.2µm/l (p=0.002).

CONCLUSIONS: The food partnership (corn-soy blend) had a positive effect on serum zinc levels. A longer intervention could have significantly improved zinc deficiency. Therefore, a longer period (e.g. 18-24 months) is recommended to clearly show the degree of increase. The authors recommend a similar study in a different area among the same age group be conducted and results compared to those of this study.

TH54

STATUS ZINC DEFICIENCY AMONGST CHILDREN IN 6 MONTHS TO 60 MONTHS OF AGE IN DIFFERENT REGIONS OF INDIA

U Kapil

All India Institute of Medical Sciences, New Delhi, India

The government of India has adopted a policy to zinc supplementation in treatment of diarrhoea, on pilot basis, in selected districts of the country, amongst children below five years of age. The prevalence of zinc deficiency in children from different regions of the country was: lacking hence present community based, cross-sectional study conducted in 5 states namely - Uttar Pradesh (Northern), Karnataka (Southern), Orissa (Eastern), Gujarat (Western) and Madhya Pradesh (Central) regions. The study data was collected between January 2006 and April 2007. The sample size was calculated considering the prevalence of zinc deficiency in children as 40%, the relative precision of 10% and 95% confidence level was considered. The sample size of 300 children per State was calculated. In each state, one district was selected randomly and in the selected district, all the ICDS projects were enlisted and one project was randomly selected from the project. In total, 1655 children of age group of 6-60 months were covered. A total of 1655 children (856 males and 819 females) in the age group of 6-60 months were covered. The data was collected on age, sex, socio-demographic profile, breast feeding and infant feeding practices; the dietary habit of the family, current and past morbidity status of each child. Anthropometric measurements of weight and height were undertaken. The blood sample of each child was collected for the estimation of its serum zinc, and CDF test. The standard Methods were used for collection, processing and storage of blood samples. A total of 1,655 children were covered: Gujarat (353), Karnataka (356), M.P (303), Orissa (445) and UP (316). The mean age of the subjects was 35.24 months ± 15.47 years. The cut-off used for zinc deficiency was 6.05 mg/d. The prevalence of zinc deficiency found was to be Gujarat, Karnataka, M.P, Orissa and UP which was found to be 64.2, 16.2, 18.9, 33.4 and 68.1 percent. It was found that 34.2% of the children who were zinc-deficient were stunted, 17.5% were wasted and 48.3% were underweight. Results: Multiple regression analysis showed that state, caste, roots & tabies and sugar & jaggery were significantly associated with zinc deficiency. Study documented high prevalence of zinc deficiency amongst children in the 5 states studied. The zinc supplementation can be undertaken along with ORS for treatment of diarrhoea the entire country as it is high deficiency exists.

TH55

DIETARY ZINC INTAKE DID NOT MEET THE CHINESE DIETARY REFERENCE INTAKES IN JIANGSU PROVINCE, EASTERN PART OF CHINA

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REFERENCE INTAKES IN JIANGSU PROVINCE, EASTERN PART OF CHINA

OBJECTIVES: To evaluate dietary zinc intake among the population of Jiangsu Province.

METHODS: Three primary schools took part in the experiment. Two schools were fed corn-soy blend while one school was not fed. Assessment of blood serum zinc levels were carried out using data drawn from 156 school children at baseline and 138 school children at follow up (after feeding). Blood samples were wrapped in foil, centrifuged at 3,000 revolutions and stored in liquid nitrogen at -70°C for onward transportation to the analysis centre. The WHO precautions and guidelines for drawing blood were followed. SPSS and Mini tab survey packages were used to analyze data into descriptive and inferential statistics.

RESULTS: At baseline, nearly all (95.7%) the pupils were with low serum zinc (<10.7µm/l). There was a significant reduction (p=0.042) to 70.2% after a 3 month corn soy blend feeding trial. The mean serum zinc improved from 8.4µm/l to 10.2µm/l (p=0.002).

CONCLUSIONS: The food partnership (corn-soy blend) had a positive effect on serum zinc levels. A longer intervention could have significantly improved zinc deficiency. Therefore, a longer period (e.g. 18-24 months) is recommended to clearly show the degree of increase. The authors recommend a similar study in a different area among the same age group be conducted and results compared to those of this study.
TH56 PUTTING ZINC IN THE PHILIPPINE HEALTH SYSTEM FOR THE TREATMENT OF DIARRHEA AMONG CHILDREN

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Background: In the Philippines, diarrhea is one of the ten leading causes of death among children. The 2003 NDHS reported that 11% of children under age five had diarrhea, an increase of 57% from the 7% level in the 1998 NDHS. The Department of Health Field Health Service Information System(DOH-FHSIS) indicated that in 2006, Acute Watery Diarrhea is second among the ten leading causes of morbidity. WHO and UNICEF signed a joint policy in May 2004 for the treatment of diarrhea in children which includes the use of low osmolarity ORS and zinc supplementation for 10-14 days. The 2003 NDHS reported high level of knowledge of ORS among Filipino mothers (92%). However, of the 32% of children with diarrhea taken to the health facility, only 42% were given ORS. While giving of zinc is part of the treatment of diarrhea in the ICMC, there is no national policy on the use of zinc supplements.

Aim: Put zinc and reformed ORS in the Philippines Health System for the treatment of diarrhea among children. 

Methods: To incorporate the new recommendations in the country’s health system, the National Center for Disease Prevention and Control, Department of Health(NCDPC-DOH) identified the following key actions to be undertaken: 1. Gathering of scientific evidences of the benefits of the treatment changes, 2. Meeting with the key stakeholders involved in the decision and implementation processes, 3. Development of updating national level policy, 4. Addressing product and supply management issues, 5. Disseminating information, training of trainers, and advocacy to local government units, and 6. Planning for monitoring and evaluation. Progress to date: Clinical and scientific evidences of the benefits of the treatments changes were collated and presented to various stakeholders. A round table discussion, convened by NCDPC-DOH and participated by representatives from the pediatric association, academic, pharmaceutical firms, NGOs and other government agencies, was held in 2006. This was followed by group meetings which led to the development of a national policy. Administrative Order No. 2007-0045: Zinc Supplementation and Reformulated Oral Rehydration Salt in the Management of Diarrhea among Children was signed by the DOH Secretary on December 17, 2007 and disseminated to the stakeholders. The indicator, % of cases of diarrhea treated with zinc & ORS, was included in the DOH-FHSIS in 2008. Until now, no policy on ORS and zinc treatment use has increased markedly due to this project, indicating a benefit of the project's scalability by measuring commercial sales data against total program costs.

Results: In the Philippines, diarrhea is one of the ten leading causes of death among children. The 2003 NDHS reported that 11% of children under age five had diarrhea, an increase of 57% from the 7% level in the 1998 NDHS. The Department of Health Field Health Service Information System(DOH-FHSIS) indicated that in 2006, Acute Watery Diarrhea is second among the ten leading causes of morbidity. WHO and UNICEF signed a joint policy in May 2004 for the treatment of diarrhea in children which includes the use of low osmolarity ORS and zinc supplementation for 10-14 days. The 2003 NDHS reported high level of knowledge of ORS among Filipino mothers (92%). However, of the 32% of children with diarrhea taken to the health facility, only 42% were given ORS. While giving of zinc is part of the treatment of diarrhea in the ICMC, there is no national policy on the use of zinc supplements.

Conclusion: Through innovative partnerships with pharmaceutical companies and local NGOs, AED upgraded RMPs’ skills and influenced their long-term behavior to improve community healthcare. Linking pharmaceutical companies to local NGOs was essential to convincing the new market by engaging local NGOs to influence RMPs in their communities.

TH57 ENGAGING RURAL INDIAN DOCTORS IN RATIONAL DIARRHEA MANAGEMENT

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Background: 75% of households in rural India seek health treatment from rural medical practitioners (RMPs). The RMPs, who are often unlicensed, therefore treat a high percentage of rural childhood diarrhea, yet they are un-reached by the efforts of the government, professional associations, and the commercial sector.

Aims: POULIN influences RMP behavior to prescribe rational diarrhea treatment. By doing this, the project demonstrates to ORS and zinc producers the scalability of developing a new market by engaging local NGOs to influence RMPs in their communities.

Methods: AED, in collaboration with several NGOs in Uttar Pradesh and four pharmaceutical companies, reaches RMPs through detailing activities. Trained NGO field personnel interact with RMPs on a regular basis to educate them on rational treatment of childhood diarrhea. A key evaluation method of the change in RMPs prescribing behavior is measuring the increase in zinc treatment and ORS distributed to rural pharmacies, which supply RMPs. AED determines the project’s scalability by measuring commercial sales data against total program costs.

Results: ORS and zinc treatment use has increased markedly due to this project, indicating a new, scalable method of reaching RMPs; more than one-third of covered RMPs now dispense zinc for diarrhea treatment, up from 0% at the project’s beginning.

Conclusion: Through innovative partnerships with pharmaceutical companies and local NGOs, AED upgraded RMPs’ skills and influenced their long-term behavior to improve community healthcare. Linking pharmaceutical companies to local NGOs was essential to convincing the companies to extend their reach to the rural areas. The unfamiliarity of the companies with this new target audience, enlisting local NGOs who know the community and the RMPs allows the companies to acquire the market knowledge needed to scale up in rural India. Companies are now investing their own funding to scale up this model.

TH58 ZINC DEFICIENCY, ZINC SUPPLEMENTATION, AND ZINC TREATMENT OF DIARRHEA

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Background: In the last two decades zinc has emerged as an important trace element with important roles in health and disease. Literature available indicates that a large proportion of the Indian population may be at risk of zinc deficiency. Cereals and pulses are the major staple foods consumed in most parts of India. Although they are not good sources of zinc and many other trace minerals, they are the only foods eaten by some communities. The amount of zinc and other trace minerals present in these cereals and pulses is not known. Nutrient Value Of Indian Foods, the standard reference guide for the nutritional composition of various foods in the country, does not have the zinc, copper, selenium and other trace mineral values for many cereals and pulses. It, however, necessary to have values for all micronutrients in cereals and pulses so that interventions like dietary modification can be planned and implemented.

With this Background we decided to estimate the zinc and copper content in cereals and pulses: a pilot study (for which facilities were available) until we had further funding to plan a large study to estimate the micronutrient content of all foods. Cereals and pulses were chosen because the relative amount and frequency of their consumption is very high as compared to other foods.

Aim: Assessment of the zinc and copper content of various cereals and pulses in Delhi.

Methods: Delhi is divided into zones by the Municipal Corporation for convenience of elections and other surveys. A detailed market survey to identify wholesale grocery suppliers was conducted and maps of shops in the four zones were drawn. This was followed by sample collection from randomly selected shops in each zone. Samples of twenty-three varieties of cereals and fifteen varieties of pulses, commonly consumed in the country, were collected from the east, west, north and south zones of Delhi. A total of six hundred and eight samples were collected (152 from each zone) of which 410 could be analyzed for both zinc and copper with the help of atomic absorption spectrophotometry.

Results: On an average the mean zinc and copper content of cereals was higher than that of pulses and whole grains had better zinc and copper content when compared to refined products.

Conclusion: In Delhi, zinc is an important element with great potential for use in public health. Cereals and pulses are the major staple foods consumed in most parts of India. Although they are not good sources of zinc and many other trace minerals, they are the only foods eaten by some communities. A detailed market survey to identify wholesale grocery suppliers was conducted and maps of shops in the four zones were drawn. This was followed by sample collection from randomly selected shops in each zone. Samples of twenty-three varieties of cereals and fifteen varieties of pulses, commonly consumed in the country, were collected from the east, west, north and south zones of Delhi. A total of six hundred and eight samples were collected (152 from each zone) of which 410 could be analyzed for both zinc and copper. A detailed market survey to identify wholesale grocery suppliers was conducted and maps of shops in the four zones were drawn. This was followed by sample collection from randomly selected shops in each zone. Samples of twenty-three varieties of cereals and fifteen varieties of pulses, commonly consumed in the country, were collected from the east, west, north and south zones of Delhi. A total of six hundred and eight samples were collected (152 from each zone) of which 410 could be analyzed for both zinc and copper. A detailed market survey to identify wholesale grocery suppliers was conducted and maps of shops in the four zones were drawn. This was followed by sample collection from randomly selected shops in each zone. Samples of twenty-three varieties of cereals and fifteen varieties of pulses, commonly consumed in the country, were collected from the east, west, north and south zones of Delhi. A total of six hundred and eight samples were collected (152 from each zone) of which 410 could be analyzed for both zinc and copper.

Conclusion: Zinc deficiency has emerged as an important trace element with important roles in health and disease. Literature available indicates that a large proportion of the Indian population may be at risk of zinc deficiency. Cereals and pulses are the major staple foods consumed in most parts of India. Although they are not good sources of zinc and many other trace minerals, they are the only foods eaten by some communities. A detailed market survey to identify wholesale grocery suppliers was conducted and maps of shops in the four zones were drawn. This was followed by sample collection from randomly selected shops in each zone. Samples of twenty-three varieties of cereals and fifteen varieties of pulses, commonly consumed in the country, were collected from the east, west, north and south zones of Delhi. A total of six hundred and eight samples were collected (152 from each zone) of which 410 could be analyzed for both zinc and copper.
**TH60**

**IDENTIFICATION OF EFFICIENT AND COST EFFECTIVE MEANS OF DELIVERING AND INCREASING THE USE OF ZINC AND ORS TO TREAT CHILDDHOOD DIARRHEA IN MADAGASCAR**

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**Background:** In Madagascar, diarrhea prevalence among children under five overall is 15% but nearly double among children 6-23 months (ORS 2003/4) and in certain regions of the country (MOHP 2007). Diarrhea is a leading cause of both morbidity and mortality due to the fact that knowledge about and use of effective treatment is low. Zinc is a new treatment protocol for both health professionals and caregivers; few caregivers (42%) provide either ORS or ORT to address critical dehydration, and 18% opt for oftentimes ineffective antibiotics or dangerous antidiarrheals.

**Objective:** to compare different delivery strategies to identify the most efficient and cost effective interventions for improving diarrhea case management and increasing correct use of zinc with ORS. Interventions: Madagascar’s MOHP was one of the first in the world to adopt the new WHO/UNICEF-recommended diarrhea treatment protocol that includes zinc, introducing pilot public sector programs in 12 districts. In parallel, USAID’s POLOUN project, which promotes zinc and ORS through private sector channels, has created a diarrhea treatment kit, containing both ORS and zinc, and is expanding access to the kit through private sector channels (both pharmacies and NGO partners). This intervention focuses not only on bundling the products but also on training pharmacy staff and community outreach/sales agents to provide appropriate interpersonal counseling to ensure correct case management and timely use and easy access to the kit in high diarrhea prevalence districts. A mass media campaign promotes use of zinc with ORS and shifting provider and consumer practices away from the use of ineffective antibiotics. Methodology: Operations research will compare various models of both facility- and community-based distribution in ten high diarrhea prevalence districts: rural vs urban, public vs private sector approaches, program vs control districts. Qualitative research with caregivers and community outreach workers will supplement the quantitative household survey that will be conducted in the key intervention as well as control districts. Final results will be available March 09. Outcomes: Our presentation will elaborate on the efficiency of various distribution models, most effective ways to promote the product, correct and consistent use, and acceptability of pricing strategies. We expect to see increases in zinc and ORS use in districts with community-based outreach/sales agents, where product is readily available and interpersonal counseling provides impetus for use. This research also provides the opportunity to examine the impact of bundling zinc with ORS on overall ORS use.

**TH61**

**NEPAL SCALES UP ZINC TREATMENT AS PART OF DIARRHEA MANAGEMENT TO FURTHER ACCELERATE THE REDUCTION IN CHILD MORTALITY**

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**Background:** Diarrhea is one of the leading causes of child death in Nepal. The prevalence of diarrhea is around 15% and it is estimated that children suffer two episodes of diarrhea in a year. About 25% of children aged 6-11 months had diarrhea. About 15,000 children under the age of five die because of diarrhea. The Government initiated use of Zinc tablets as part of diarrhea management. As per the protocol, any child suffering from diarrhea is to be provided Zinc tablet for 10 days (children below six months half a dose) along with low osmolar ORS. Methodology: Nepal has 75 districts. Each district has Village Development Committees (VDC). Each VDC has a health facility, and VDC is divided into nine wards (the smallest administrative unit). In each ward, there are around 80-150 households. Every ward has at least one Female Community Health Volunteer (FCHV), who has been providing various child and maternal care services. Zinc tablets are distributed through health facilities, as well as FCHVs who are already distributing ORS packets in the community. The programme has been initiated in a phase wise manner and in each district where the intervention starts, a cascade level training of health workers and the community volunteers is conducted.

A social marketing campaign has also been initiated in the districts to mobilize private health sector to initiate use of Zinc tablets as part of the treatment. Results: The Zinc programme started in two districts in 2006 and the intervention has been expanded to 17 districts. The Government has a plan to cover all 75 districts within 2009. In 2008, the programme will be initiated in 16 districts and remaining 22 districts will be covered in 2009. Within a two year period, coverage of Zinc tablets is around 30% according to a recently conducted survey in two districts. Conclusion: The main constraints that have affected the coverage of the intervention include erratic and inadequate supply of the tablets, poor awareness about the intervention and a large proportion of mothers seek treatment through the private sector which is presently not using Zinc tablets.

**TH62**

**KEY DETERMINANTS TO OBSERVING A 10-DAY TREATMENT WITH ZINC DURING DIARRHOEA EPISODE IN CAMEROON**

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**Background:** Recent scientific findings showed that zinc supplementation for 10-14 days during an acute diarrhoea episode reduces the duration and severity of the episode and reduces the incidence of diarrhoea in the following 2-3 months. Based on this, UNICEF/WHO and other partners issued a joint statement in 2004 on the clinical management of acute diarrhoea in children under five recommending zinc supplementation for 10-14 days as one of the four rules. However, factors affecting compliance to treatment need to be identified and addressed in order to achieve successful scaling-up the use of zinc in the treatment of diarrhoea. This is why a study was carried out in ten health catchment areas of the Bertoua Health District in the east province of Cameroon.

Aims: The aim of the study was to identify key determinants of completing a 10-day regimen of zinc treatment during a diarrhoea episode.

Methods: A door to door barrier analysis survey was conducted using individual interview. The questionnaire consisted of six questions: two questions to explore the perceived positive and negative consequence in completing the treatment; two questions on the perceived self efficacy and two questions on the perceived social norms. A total of 60 mothers were involved in the study, 30 of whom had completed the treatment for 10 days (Doers) and 30 who had not (Non-Doers) in the past two weeks. Statistical analysis where performed to compare Doer and Non-Doer outcomes.

Results: some characteristics of mothers interviewed are: median age 25 years, 93% have attended at least primary school, 66% are married, they are christian (87%), their income is mainly from farming (60%). Three major key determinants were identified: the first was the perceived positive consequences of completing the treatment for Diuers, Both Doers and Non-Doers did not mentioned preventative advantages to completing the treatment and they did not also find any negative consequences; the second determinant was the longer duration of treatment where Non-Doers mentioned this barrier significantly than Doers; the third determinant was the perceived social norms within which Doers were significantly self motivated to complete the treatment than Non-Doers.

Conclusions: the identification of key determinants will help in developing BEC activities to address the key factors that affect compliance to treatment, designing messages that are relevant to audience and preparing counselling sessions.

**TH63**

**DOES ZINC SUPPLEMENT REQUIRED IN PEDIATRIC CELIAC DISEASE?**

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**Background & Aims:** Celiac disease (CD) is a common cause of malabsorption in North Indian Children. The comparative data about effect of gluten free diet (GFD) with or without zinc supplementation on serum zinc levels is scarce. The Aims of this study were to assess serum zinc levels in children with CD, to correlate serum zinc levels among the CD patients with short stature and diarrhea and to compare serum zinc levels in deficient patients on GFD with or without four weeks of zinc supplementation.

**Materials & Methods:** A prospective randomized open label controlled study was conducted on 134 children diagnosed with CD from July 2006 to December 2007. All the patients underwent hemogram, liver function tests, Iga anti-tissue transglutaminase (anti-tTG) antibodies, OSI, hematocrit and serum zinc levels at baseline and after 4 weeks. Zinc deficient patients (n=96) were randomized in 2 groups. Group G (n=48) received GFD without zinc supplementation for 4 weeks. Group G+Z (n=48) received GFD with zinc supplementation for 4 weeks.

**Results:** Mean age was 6.2 ± 1.2 years, mean weight was 14.6 ± 5.5 kg and mean height was 102.6 ± 17.2 cm. Male to female ratio was 1.5:1. Major symptoms at presentation were diarrhea (54.5%), Failure to thrive (22.2%), abdominal distension (41%), anemia (40%) and pain abdomen (19.4%). Mean serum anti-tTG level was 164.2 Ul/ml (range 1-749 Ul/ml) and levels correlated with the severity of duodenal mucosal damage. Mean serum zinc levels at baseline and after 4 weeks were 52.3 μg/dl and 71.9 μg/dl in group G and 51.2 μg/dl and 74.9 μg/dl in group G+Z, respectively (p=0.05). Rice in serum zinc level was significant in individual group with or without zinc supplementation (19.5 μg/dl in group G and 23.5 μg/dl in group G+Z) after 4 months of zinc treatment was not significant. Mean serum zinc levels at baseline and rice were statistically similar at 4 weeks in patients with diarrhea and short stature.

**Conclusions:** There is zinc deficiency in patients with celiac disease. Gluten free diet is the mainstay of treatment. Serum zinc levels rise with GFD irrespective of zinc supplementation.
ZINC SUPPLEMENTATION DOES NOT AFFECT THE BREAST MILK ZINC CONCENTRATION OF LACTATING WOMEN BELONGING TO LOW SOCIOECONOMIC POPULATION

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Background: Although zinc supplementation does not affect breast milk zinc concentrations among lactating developed country women, but may potentially affect breast milk zinc concentrations among lactating women with sub-optimal zinc status from developing countries.

Methods: In a randomized, double-blind trial we evaluated the effect of zinc supplementation on breast milk zinc concentrations. Lactating women 0-2 mo and 4-6 mo postpartum were randomly allocated to receive either multivitamins plus zinc 40 mg daily in 2 divided doses (n=50, 0-2 mo; n=51, 4-6 mo) or same supplement without zinc (n=61, 0-2 mo; n=50, 4-6 mo) for a duration of 1 month. A mid-feeding 10 ml breast milk sample was collected at baseline and at the end of study.

Result: Following zinc supplementation, the change in breast milk zinc concentrations (µmol/L) between the zinc plus multivitamin group (ZMV) and multivitamin group (MV) of lactating women both at 0-2 months (ZMV -18.9 ± 28.2, MV -22.1 ± 16.1) and 4-6 months post partum (ZMV -2.2 ± 6.6, MV -0.6 ± 9.5) was similar. Among 0-2 mo postpartum women with a baseline breast milk zinc concentration of <45.0 µmol/L, zinc supplementation had a non-significant lowered rate of decline in breast milk zinc concentration (ZMV: 1.4 ± 19.5, MV: 9.7 ± 8.5, p<0.059) than the multivitamin group, while in 4-6 mo postpartum women no significant differences were observed. Overall, median breast milk zinc concentrations at each month of lactation were similar to those reported from developed countries. Zinc supplementation only affected breast milk concentrations in early lactation, in a subgroup with low breast milk zinc concentrations.

Conclusion: Breast milk zinc concentrations seem to be maintained by active transport and unaffected by zinc supplementation in a population of low zinc intake.
VITAMIN D DEFICIENCY: A PUBLIC HEALTH PROBLEM IN OMAN

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Background: Oman is a country blessed with rich, bright sunshine most of the year. However, due to harsh weather conditions and modern lifestyle, outdoor activities are only minimal. Moreover, the traditional dress of Omani women restricts sun exposure. View of a large number of reported cases of rickets and osteoporosis in local hospitals, a subset of which were confirmed by the Centers for Disease control and Prevention (CDC).

Methods: In the 2004 micronutrient survey in Oman, population clusters were selected using the “proportion to population size” (PPS) methodology. Omani households with eligible women of reproductive age or preschool children included. A questionnaire targeting the women’s food habits and practices, including questions related to use of milk, cooking oil and ghee, was also completed and venous blood samples collected. 25-hydroxyvitamin D3 was determined by liquid chromatography-tandem mass spectrometry performed by the Centers for Disease control and Prevention (CDC).

Results: In total, 252 serum samples were analyzed. The mean age of women was 27.2 ± 6.8 years old. The mean serum concentration of 25(OH)D3 was 26.3 ± 5.7ng/ml. There were significant differences in serum concentration of 25(OH)D3 between racial-ethnicity groups (P < 0.05). There was no difference in mean 25(OH)D3 and calcium concentration by ethnicities as shown in table below:

<table>
<thead>
<tr>
<th>Serum nutrient conc.</th>
<th>Race-ethnicity</th>
<th>Mean ± SD</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-hydroxyvitamin D3 (ng/ml)</td>
<td>Hispanic</td>
<td>26.3 ± 5.7</td>
<td>25.1 - 27.6</td>
</tr>
<tr>
<td></td>
<td>Non-Hispanic</td>
<td>26.6 ± 9.0</td>
<td>24.6 - 28.6</td>
</tr>
<tr>
<td>Calcium (mg/dl)</td>
<td>Hispanic</td>
<td>9.8 ± 0.4</td>
<td>9.8 - 9.9</td>
</tr>
<tr>
<td></td>
<td>Non-Hispanic</td>
<td>9.8 ± 0.4</td>
<td>9.7 - 9.9</td>
</tr>
</tbody>
</table>

There was no relationship between dietary intakes of vitamin D and the serum 25(OH)D and calcium levels. In multivariate models, fat intake and female gender were significant predictors of serum calcium. Fat intake, height and weight were age, and sex were significant predictors of serum 25(OH)D.

Conclusion: Suboptimal vitamin D status is common among otherwise healthy young children. Fat intake was a significant predictor of 25(OH)D and calcium status. 

TH67 BLEEDING DISORDERS IN EARLY INFANCY IN RURAL BANGLADESH AND MATERNAL VITAMIN K STATUS

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Background: Infantile bleeding disorders, vitamin K deficiency bleeding (VKDB), PIVKA-II, Bangladesh. Acknowledgement: The JiVitA Project is supported by the United States Agency for International Development (USAID), The Bill and Melinda Gates Foundation and the Sight and Life Research Institute.

Methods: In northern rural Bangladesh the incidence of infant bleeding disorders is high and prevalence of vitamin K deficiency has been reported. We assessed in northern rural Bangladesh the incidence of infant bleeding disorders, vitamin K deficiency bleeding (VKDB), PIVKA-II, Bangladesh. Maternal vitamin K concentration was not associated with bleeding, though newborn vitamin K deficiency remains a suspect cause.

Keywords: Infantile bleeding disorders, vitamin K deficiency bleeding (VKDB), PIVKA-II, Bangladesh.

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Background: Infantile bleeding disorders, vitamin K deficiency bleeding (VKDB), PIVKA-II, Bangladesh. Acknowledgement: The JiVitA Project is supported by the United States Agency for International Development (USAID), The Bill and Melinda Gates Foundation and the Sight and Life Research Institute.

Results: Incidence of any bleeding in the 1st 6 months of life was 54.2 % per 1000 infants. Incidence of early (<48 hours of birth) nuchal, subdural and umbilical bleeding was 2.5, 2.4 and 7.2 per 1000 with associated fatalitity rates of 94.9%, 80.3% and 38.2%, respectively. Incidence of “bleeding” (2-7 days) was 3.8, 0.7 and 10.3 per 1000 with associated fatalitity rates of 89.8%, 70.0% and 0.9%, respectively. Late (8 days to 6 months) bleeding incidence was 4.5, 4.5 and 14.8 per 1000 with associated fatalitity rates of 23.7%, 9.2% and 4.0%, respectively.

Gestational age at birth, and maternal parity, but not plasma PIVKA-II levels were associated with infant bleeding.

Conclusions: Early infant bleeding is common and associated with high fatality risk in rural Bangladesh. Maternal PIVKA-II concentration was not associated with bleeding, though newborn vitamin K deficiency remains a suspect cause.

Keywords: Infantile bleeding disorders, vitamin K deficiency bleeding (VKDB), PIVKA-II, Bangladesh.

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Methods: In northern rural Bangladesh the incidence of infant bleeding disorders, vitamin K deficiency bleeding (VKDB), PIVKA-II, Bangladesh. Maternal vitamin K concentration was not associated with bleeding, though newborn vitamin K deficiency remains a suspect cause.

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Keywords: Infantile bleeding disorders, vitamin K deficiency bleeding (VKDB), PIVKA-II, Bangladesh.
F02
THE OBAAPIAVITA TRIAL: IMPACT OF WEEKLY VITAMIN A SUPPLEMENTATION (VAS) ON PREGNANCY-RELATED MORTALITY IN GHANA

Background: More than 100,000 women die each year as a result of pregnancy and childbirth; this represents one death per minute worldwide. The Safe Motherhood Programme advocates provision of skilled attendance at delivery plus emergency obstetric care at the district hospital level for the 10-15% of women who develop potentially life-threatening complications. However, for the poorest countries the capacity to provide such services is some years down the line. If an effective low technology intervention to reduce maternal mortality could be found it would be of the highest public health importance. Vitamin A supplementation (VAS) of adult women could be such an intervention.

Aim: The aim of the ObaaPavia trial is to assess whether VAS should be a component of safe motherhood programmes. The main objectives are to evaluate the impact of weekly low dose VAS given to all women of reproductive age on pregnancy-related mortality, overall mortality, pregnancy-related morbidity and perinatal and infant mortality.

Methods: This is a cluster-randomized, double-blind, placebo-controlled trial involving all women of reproductive age living in 18 districts in rural Ghana. Capsules are distributed at 4-weekly home visits, and data collected on pregnancies, births, vital events such as deaths and migrations, adherence, socio-demographic status, maternal morbidity and cause of death. Capsule distribution is supported by an extensive information, Education and Communication programme, designed to ensure good adherence. The results, together with those from Nepal and Bangladesh, will inform the policy debate on whether vitamin A interventions should become a key component of maternal health initiatives.

F01
NEONATAL VITAMIN A SUPPLEMENTATION FOR THE PREVENTION OF MORTALITY AND MORBIDITY IN INFANCY: SYSTEMATIC REVIEW OF RANDOMIZED CONTROLLED TRIALS

Aims: To evaluate the effect of neonatal vitamin A supplementation (VAS) on infant mortality, morbidity and adverse effects.

Design: Systematic review, meta-analysis and meta-regression of randomized controlled trials.

Data sources: Electronic databases and hand search of reviews, and abstracts and proceedings of micronutrient conferences.

Results: Amongst 8 included trials, all from developing countries, data on mortality, morbidity and adverse effects could be meta-analyzed from 6, 4 and 6 trials, respectively. There was no evidence of a reduced risk of mortality during infancy (RR 0.93, 95% CI 0.75 to 1.12; P=0.393 random effect; Q=54.1%) or of adverse effects including bulging fontanelle (RR 1.16, 95% CI 0.81 to 1.65; P=0.418; I2=65.3%) amongst infants supplemented during the neonatal period in comparison with those receiving placebo. Limited data does not indicate a reduced risk of mortality during neonatal period (RR 0.90, 95% CI 0.75 to 1.08, P=0.270; I2=0%), cause specific mortality (respiratory, diarrheal and others), common morbidities (diarrheas and others) and hospitalization. However, the data suggests an increased risk of acute respiratory infection and a reduced risk of clinical visits among supplemented neonates. No variable emerged as a significant predictor of mortality during infancy.

Conclusions: There is no evidence that vitamin A supplementation during the neonatal period is associated with reduced risk of infant mortality and morbidity or of adverse effects. There is thus no justification for initiating neonatal VAS as a public health intervention in developing countries for reducing infant mortality and morbidity.

F03
WHAT IS THE EFFECT OF STARTING MICRONUTRIENT SUPPLEMENTS EARLY IN PREGNANCY ON BIRTHWEIGHT, DURATION OF GESTATION AND PERINATAL MORTALITY? A DOUBLE-BLIND CLUSTER RANDOMIZED CONTROLLED TRIAL IN RURAL WESTERN CHINA

Background: Many women in developing countries present for antenatal care and commence nutrient supplements in the second trimester of pregnancy. Does starting nutrient supplementation early in pregnancy confer any benefits? Based on data collected in a randomized controlled trial of antenatal micronutrient supplementation, we assessed the modifying effects on the trial outcomes of starting supplemetings in the first trimester of pregnancy.

Methods: A cluster randomized double-blind controlled trial was conducted in two rural counties in Shaanxi province in northwest China. A total of 5828 pregnant women with 4697 live births from 531 villages were enrolled in the trial. Villages were randomised for all pregnant women to take either daily folic acid (400 µg) [control], iron [60mg]/folic acid [400 µg] [FeFol], or Multiple Micronutrients [MMN] with one recommended allowance of 15 vitamins and minerals [iron 30mg]. Participants received supplements fortnightly and attended 1 antenatal care check at NCIC centres. Main outcome measures were birth weight and length, which were measured within 2 hours of delivery. Neonatal survival was assessed at the six week follow up visit. Analysis was by intention to treat with GEE models to adjust for cluster randomised design & stratified by timing of start of supplementation.

Findings: In women starting supplements <12 weeks of gestation, FeFol, compared to folic acid alone, significantly increased the birth weight by 70g (95% CI: 17.9, 121.6), reduced neonatal mortality (LRB) by 38% (RR 0.62, 95% CI 0.39, 0.99), reduced early preterm delivery (< 34 weeks) by 66% (RR 0.34, 95% CI 0.12, 1.29) and with borderline statistical significance reduced neonatal mortality by 69% (RR 0.31, 95% CI 0.11, 1.03). FeFol started <12 weeks had no effect on birthweight, or LRB, although there were non significant reductions in preterm delivery and neonatal mortality. MMN started <12 weeks significantly increased birth weight by 73g (95% CI 0.21, 125.3), tended to reduce the low birth weight (LRB) by 34% (RR 0.65, 95% CI 0.40, 1.00) but had no significant effects on preterm delivery or neonatal mortality. MMN started >12 weeks had no effect on birthweight, LRB, preterm delivery or neonatal mortality.

Interpretation: There are programmatically important benefits for women starting nutrient supplementation in the first trimester of pregnancy. Greater benefits for perinatal outcomes were found when FeFol rather than MMN supplements were commenced in the first trimester of pregnancy. FeFol supplements should be available for women to start using prior to antenatal care.
F05  ASSESSING THE SUSTAINABILITY AND ENHANCING REALISTIC PLANNING AND BUDGETING FOR TWICE-YEARLY VITAMIN A SUPPLEMENTATION IN THE CONTEXT OF A HEALTH SWAP AND DECENTRALIZED HEALTH SYSTEM - EXPERIENCES FROM TANZANIA

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Background: In the last decade, the proportion of children receiving twice yearly vitamin A supplementation (VAS) has increased considerably throughout the developing world. It is also increasingly recognized that governments need to increase commitments to VAS programs to ensure long-term sustainability. Countries that are aspiring to sustain high coverage programs, such as Tanzania, require comprehensive information on all aspects of program sustainability in order to identify, address and monitor weak program components. Of particular concern is the financial sustainability, particularly where the health system is decentralized and sub-national government authorities have the autonomy to decide how resources are allocated.

Aims: To undertake district self-assessments on the sustainability of the national VAS program in Tanzania, and to mitigate the impact of new donor funding modalities on VAS coverage and improve the district financial sustainability of VAS by developing and promoting the utilization of a computerized planning and budgeting tool (PBT), coupled with advocacy

Methods: A sustainability assessment tool was developed in the form of a structured questionnaire through a multi-stakeholder workshop followed by field-testing. The tool covered eight program components agreed to be associated with the sustainability of public health interventions. The assessment tool was self-administered by all districts in Tanzania Mainland in February and March 2007. The data were analyzed to identify weak program components and to rank districts according to their degree of sustainability. The PBT was developed through a consultative process involving district to national level stakeholders. Government officials from the health departments of all mainland districts were oriented on the PBT prior to the start of the planning and budgeting cycle for the fiscal year (FY) 2008-9. This orientation was combined with advocacy to build capacity of district officials to defend budgets and ensure three inclusion in district plans. To assess the impact of the PBT and advocacy on the allocation of financial resources for VAS we compared the FY 2007-8 and FY 2008-9 VAS budgets.

Results: The sustainability assessment highlighted the key factors threatening the sustainability of VAS in Tanzania. It demonstrated strengths, weaknesses and differences that were present across and between districts that indicate opportunities for improvement. An excel-based PBT to estimate the financial resources and supplies required annually for VAS was developed and rolled out in Tanzania Mainland. Follow-up with all districts after the submission of their budgets to the national secretariat indicated that over 80% of councils used the tool in developing their FY 2008-9 budgets, and the budget allocated per child increased from Tanzanian Shillings 119 to 210 between 2007-8 and 2008-9.

Conclusions: The sustainability assessment provides a comprehensive tool for countries to assess their VAS programs for vulnerability. It is particularly useful after attaining a stable coverage and if districts have more overall responsibility for planning, implementing, and financing VAS distribution. Introduction and promotion of a computer-based PBT and accompanying advocacy tools could facilitate increased and realistic allocation of resources by districts to support twice yearly VAS in decentralized health systems.

F06  REVIEW OF SUPPLY VERSUS UTILIZATION: SUPPLY CHAIN IMPROVEMENTS FOR VITAMIN A CAPSULES IN DRC, INDONESIA, KENYA, NIGERIA, PAKISTAN AND THE PHILIPPINES

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Background: Micronutrient supplementation and anemia reduction programs have historically been limited by not incorporating pharmaceutical systems strengthening interventions. Evidence indicates that even where Vitamin A distribution and iron supplementation are a universal part of policy, supplies have been a constraining factor. Anemia reduction supplies—iron and folic acid (IFA)—are often integrated into the regular pharmaceutical supply systems in most situations. However, their regular availability and use remains problematic.

Aims: To improve program impact, the Academy for Educational Development’s A2Z Project and Management Sciences for Health’s Strengthening Pharmaceutical Systems (SPS) Project have been identifying key challenges and testing interventions related to the selection, procurement, distribution and use of quality micronutrients and anemia reducing medicines.

Methods: In partnership, A2Z and SPS initiated assessments and small-scale supply improvements in selected areas of India (2007-8), Uganda (2008), and Cambodia (2008). Data were collected through semi-structured interviews, review and observation. In Ethiopia and India, assessments had indicated that IFA was out of stock 25% of the time at the state level, 32%-60% of the time at district level sites, in Uttar Pradesh State, India, IFA was out of stock between 41%-78% of the time at selected subcenters. In Uganda, IFA stock-outs ranged from 27%-100% of the time in selected districts. The Cambodia assessment revealed weaknesses in the supply of IFA in a selected district. These case studies are analyzed using quantitative and qualitative data.

Results: A process of stakeholder collaboration, assessments, options analysis, implementation of interventions, and monitoring and evaluation will be proposed with a focus on the findings from India and Uganda. Data will be presented to demonstrate key factors to address in scaling up the supply side of proven interventions to reduce morbidity and mortality.

Conclusion: Results will be used to make a compelling case for a global framework to address supply management for anemia reduction.

F07  ADDRESSING PHARMACEUTICAL MANAGEMENT TO REDUCE MICRONUTRIENT DEFICIENCIES

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Background: Micronutrient supplementation and anemia reduction programs have historically been limited by not incorporating pharmaceutical systems strengthening interventions. Evidence indicates that even where Vitamin A distribution and iron supplementation are a universal part of policy, supplies have been a constraining factor. Anemia reduction supplies—iron and folic acid (IFA)—are already integrated into the regular pharmaceutical supply systems in most situations. However, their regular availability and use remains problematic.

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Results: A process of stakeholder collaboration, assessments, options analysis, implementation of interventions, and monitoring and evaluation will be proposed with a focus on the findings from India and Uganda. Data will be presented to demonstrate key factors to address in scaling up the supply side of proven interventions to reduce morbidity and mortality.

Conclusion: Results will be used to make a compelling case for a global framework to address supply management for anemia reduction.
EVIDENCE-BASED PROGRAMS

F08  TWO COMMON SINGLE NUCLEOTIDE POLYMORPHISMS IN THE GENOME ENCODING β-CAROTENE 15,15'-MONOXYGENASE ALTER β-CAROTENE METABOLISM IN FEMALE VOLUNTEERS

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β-carotene absorption and/or conversion into retinol is extremely variable among individuals. The proportion of low responders to β-carotene in well nourished individuals has been estimated to be 65% [1]. So, the mechanisms underlying this variability are still not well understood, and could arise from genetic variations in the genes involved in the absorption, transport and/or conversion of pro-vitamin A carotenoids to retinol. The key enzyme responsible for β-carotene conversion into retinol is β-carotene 15,15'-monooxygenase (BCMO1). A first indication that genetic Background might influence the conversion efficiency in humans comes from the discovery of a very rare missense mutation in the BCMO1 gene which is associated with xanthophagia hirsuta and xanthoconia [2]. We have screened the top open reading frame of the BCMO1 coding region that lead to the identification of two common non-synonymous variants (c.625G>C and c.4379T>C) with variant allele frequencies in a Caucasian population of 24% and 26%, respectively. In vitro biochemical characterisation of the recombinant 2875/3799 double mutant revealed a reduced catalytic activity of BCMO1 by 57%. Assessment of the responsiveness to a pharmacological dose of β-carotene in female volunteers confirmed that carriers of both the A379P and R675S/4797P variant had a reduced ability to convert β-carotene as indicated through reduced retinol-palmitate/β-carotene ratio (~32% and ~69%, respectively) and increased fasting β-carotene concentration (~160% and ~240%, respectively). Our data show that there is genetic variability in β-carotene metabolism and may provide an explanation for the molecular basis of the poor converter phenotype within the population.

Acknowledgement: This work was supported by the BBRC and the European Nutrigenomics network NUGEN.

References:

F09  SERUM RETINOL TO RETINOL-BINDING PROTEIN (RBP) IS LOW IN OBESE ADULTS DUE TO ELEVATED APO-RBP

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In addition to its well established role as the major blood carrier of retinol, serum retinol-binding protein (RBP) has recently been referred to as “RBP4,” a new adipokine. This development was inaugurated by a series of studies in mice and humans revealing a strong relationship between serum RBP and obesity-induced insulin resistance. These novel findings spawned widespread fervor to understand the role of RBP in obesity and insulin resistance, generating a considerable pool of publications in a relatively short amount of time. While some studies have validated the original observations of elevated RBP in obesity and insulin resistance in humans, others have not. Often lacking in these publications are data for apo-RBP, which may act as an adipokine, and holo-RBP, which transports vitamin A. The relations between serum RBP, retinol, retinyl esters, BMI, and measures of insulin resistance were determined in obese adults. Fasting blood (~9:00 a.m.) was collected from obese men and women (n = 76) and blood chemistries were obtained. Retinol and retinyl esters were quantified by HPLC and RBP by ELISA. RBP and retinol were determined in age and sex-matched, nonobese individuals (n = 41) for comparison. Serum apo-RBP was two-fold higher in obese (~0.09 ± 0.02 μmol/L) than nonobese subjects (0.04 ± 0.01 μmol/L) (P < 0.001). The retinol to RBP ratio (retinol/RBP) was significantly lower in obese (~0.73 ± 0.13) than nonobese subjects (~0.90 ± 0.23) (P < 0.001) and RBP was strongly associated with retinol in both groups (r = 0.71, P < 0.001) and r = 0.90, P < 0.001, respectively. In obese subjects, retinol was associated with insulin (r = 0.26, P < 0.05), homeostatic model assessment of insulin resistance (r = 0.29, P < 0.05) and quantitative insulin sensitivity check index (r = -0.27, P < 0.05). RBP was associated with BMI only when obese and nonobese subjects were combined (r = 0.21, P = 0.01). Elevated serum RBP, derived in part from apo-RBP, was more strongly associated with retinol than with BMI or measures of insulin resistance in obese adults. Investigations into the role of RBP in obesity and insulin resistance should include retinol to facilitate the measurement of apo-RBP and retinol:RBP. When evaluating the therapeutic potential of lowering serum RBP, consideration of the consequences on vitamin A metabolism is paramount. Supported by the National Institutes of Health National Center for Research Resources, grant number 5P50GM076516.

F10  SERUM PROTEOME REFLECTS MATERNAL MICRONUTRIENT STATUS IN NEPAL: A STUDY OF THE NUTRIENTPROTEOME TO DISCOVER MICRONUTRIENT BIOMARKERS

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Background: Prevention of micronutrient (MN) deficiencies is a global priority, but there are currently no means to detect multiple MN deficiencies in a timely, inexpensive, and simple way in the developing world. Proteomics may offer new ways to assess multiple MN deficiencies. Concentrations of nutrient-related serum proteomic biomarkers (nutriproteome) could covary with MN status indicators, or respond to nutrient interventions to serve as markers of status.

Aims: To combine proteomics and bioinformatics with conventional nutrient assessment Methods to discover, quantify and identify multiple serum proteins that correlate with MN status changes and in MNs.

Methods: We pilot tested this hypothesis in a sample of 23 pregnant Nepalese women taking part in a multiple MN supplement trial, and delivered term, low-birth-weight infants. Mothers were phlebotomized in the 1st and 3rd trimesters (TM). Pairwise serum specimens were analyzed for 11 micronutrient indicators (carnitines A, D, E, K, B6, B12 and biotin, iron, zinc, and copper), plus total homocysteine by conventional Methods. Serum was allergy depleted of albumin, IgA, IgG, anti-trypsin, transferrin and haptoglobin, analyzed for relative protein abundance by 2-dimensional in-gel electrophoresis, and ~4500 unique protein spots were picked for in-gel digestion, detection by LC tandem mass spectrometry and identification using a web-based peptide search engine. Spot abundance and nutrient concentrations were provisionally accepted as significant when r (~0.5), p < 0.05, and ≥ -0.50 where a low (H-influence) score reflects uniform spread along the x-axis.

Results: Serum MN concentrations were associated with relative abundance of 168 and 194 protein spots in the 1st and 3rd TM, respectively. 1st to 3rd TM changes in relative abundance of 182 proteins were correlated with gestational changes in serum levels for multiple nutrients. The largest number protein associations were observed for copper (~569), 25 (0.60 vit (D in 38), α-tocopherol (n = 36), Hb (n = 32), and retinol (n = 15); 38 proteins covered with homocysteine. In this small sample, proteins most associated with nutrient concentrations included those of the immune cascade (eg, complement-related), involved in inflammation control (α2-macroglobulin, pregnancy zone protein) and metabolism or transport of iron (serum transferring, hemopexin), copper (ceruloplasmin) and vitamin A (apo-lipoprotein A-1).

Conclusion: The serum nutriproteome may hold promise for identifying multiple biomarkers of multiple micronutrient deficiencies, and making new multiple platforms for assessing MN status in the future.

F11  CONDITIONAL CASH TRANSFER PROGRAMS AND MICRONUTRIENT DEFICIENCIES: ARE WE MISSING AN OPPORTUNITY?

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Background: Conditional cash transfer programs (CCTs) have become increasingly popular in developing countries. These programs typically provide cash transfers to poor households to alleviate short-term poverty and food insecurity, conditional upon families investing in their children’s health and education. Typically, families have to comply with a schedule of preventive health visits for all family members, and enroll and maintain their children in school. The health and nutrition inputs usually include behavioral change communication (BCC) on nutrition monitoring, immunization and health check-ups. Some, like the Mexico program, also provide a micronutrient (MN)-fortified nutrition supplement for mothers and children. Little is known about the potential of CCTs to improve MN status.

Aims: This review summarizes evidence on the impact of CCTs on maternal and child MN nutrition, and assesses how they may be strengthened to increase their contribution to reducing MN malnutrition globally.

Methods: The only two programs (Mexico and Nicaragua) that were evaluated for their impact on MN focused on iron deficiency anemia measured by hemoglobin (Hb). In Nicaragua, no impact was found in 6-59 mo old children. In Mexico, modest effects were found in rural areas, intervention children 12-24 mo of age had higher Hb levels than control children (11.12 v. 10.75 g/dL, P=0.01) after one year of exposure, but anemia remained high (44%); in urban areas, the program increased Hb by 0.39g/dL in children 2-3 y, but without changing anemia prevalence. No effect was found in older children.

Conclusions: Notwithstanding their limited (documented) impact, CCTs could provide an excellent opportunity to improve maternal and child MN status for the following reasons: 1) They are targeted to — and effectively reaching — poor populations who suffer highest burdens of MN deficiencies; 2) Coverage of CCTs is usually high, and in some cases reaching national scale; 3) Households are provided with cash, which they have shown to be used to improve household consumption of MN-rich foods and diet quality; 4) Most CCTs include a BCC component, which could be strengthened to better promote optimal child feeding, care, health seeking behaviors and use of MN fortified supplements where available. The full potential of CCTs to improve MN nutrition is yet to be unleashed. It will require systematic program evaluation research that uses a program theory framework to identify, evaluate and document the multiple impact pathways by which these programs can improve MN nutrition. Problems have been reported in supplement distribution, intra-household sharing and adequate consumption. To unlock the full potential of CCTs, research is needed to eliminate these barriers.
**F12**

Homestead Food Production Contributes to Household Food and Nutrition Security and Decreased Anemia Among Young Children – Lessons Learned from Scaling-Up Programs in Asia (Bangladesh, Cambodia, Nepal and Philippines)

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Background: Micronutrient (MN) deficiency, particularly anemia, is a serious public health problem among young children and women throughout Asia. HKI and partners have been implementing homestead food production programs (HFPP) in Asia to increase and ensure year round availability and intake of MN foods by women and children.

Aim: To review the impact of HFPP and identify lessons learned for scaling to new areas.

Methods: Baseline (BL) and endline (EL) data from HFPP in 4 countries covering 28,000 households (HH) between 2003-2007 was reviewed. Data, using pre-coded questionnaires, were collected from program HH participating in HFPP and from control HH in non-HFPP villages. Blood samples were collected from ~1200 non-pregnant women and ~1000 children < 5y at BL and EL to measure change in hemoglobin level, using hemocue. A review of the M&E process and obstacles to scaling up was also undertaken.

Results: HFPP significantly improved diet diversification (2-3 at BL to 8-9 at EL (P<0.001)) and increased animal food consumption among program HH compared to the control group in all countries. Program HH consuming animal foods (e.g. liver) significantly increased from 18 to 42% (P<0.001) from BL to EL compared to the control group (12-18%) at EL. The median income from HFPP produce significantly increased (P<0.001) among the target HH ($5.1 to $7) compared to the controls. The money was mostly spent on foods such as meat (P<0.005), cooking oil and fish (P<0.05). Anemia prevalence among children < 5y decreased in all countries; however, the change was only significant (P<0.001) in Bangladesh and the Philippines [Bangladesh 63.9-45.2% (P<0.001), Nepal 65.0-57.5% (P<2.009), Philippines 42.9-16.6% (P<0.001), Cambodia 78.0%-70.2% (P=0.153)]. Anemia prevalence remained unchanged in control children in Nepal and slightly decreased in the other 3 countries.

Impact on health and other nutrition was not measured.

Conclusion: HFPP reduced anemia among children <5y. Program HH diversified their diet by increasing intake of MN-rich foods and generating income used to buy other food, thus contributing to improved HH food and nutrition security. Considering the current global food crisis, programs such as HFPP should be scaled up quickly to mitigate the adverse effects of rising food prices and reduced access to food in the marketplace. HFPP M&E should be strengthened to see impact on health, nutrition and economics. HFPP should be integrated with synergistic programs to accelerate scale-up. Essential nutrition actions should be integrated into HFPP for better impact on health and nutrition.

**F13**

Breakthrough Technologies and Approaches to Ensure All-Year-Round Adequate Supply of Micronutrients Through Vegetable Gardening

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This paper describes how through capacity building, food insecure, HIV affected communities in an arid district of Lesotho were enabled to produce adequate quantities and variety supply of vegetables all year round. Lesotho was piloted for the project: “Protecting and Improving Food and Nutrition Security of Orphans and HIV/AIDS Affected Children in Lesotho and Malawi”, that was developed as a mitigation response to the HIV pandemic in southern Africa. The project, funded by the German Federal Ministry of Food Agriculture and Consumer Protection (BMELV) and facilitated by three United Nations agencies (FAO, UNICEF and WFP), was implemented from November 2004 to May, 2008 by the Governments of Lesotho and Malawi. The experience of Lesotho is presented in this discussion. The overall objective of the project was to improve household food and nutrition security of vulnerable children affected by HIV and their communities. As an initial pilot district, of Mafeteng, was piloted for the project. As a result of the high HIV prevalence rate in the district (21.6%), labour is decreased due to illness and death, adult mortality rate is high, productivity (as in food production and paid work) declines and thus family income is significantly reduced, and livelihoods are eroded. Consequently, household vulnerability is increased and resilience in dealing with stress decreased. Because of the arid conditions, poor soils, and very low winter temperatures of the district, food production is a challenge, yet the poor nutritional status (40% stunting) and increased micronutrient needs due to HIV call for increased intake of micronutrient-rich foods.

In view of the challenging agro-ecological conditions in Mafeteng and the socio-economic circumstances of the target group, a breakthrough technology, bio-intensive agricultural techniques of vegetable production, keyhole gardening and double dug methods were introduced. Keyhole gardens were ideal: they are a breakthrough technology, bio-intensive agricultural techniques of vegetable production, keyhole gardening and double dug methods were introduced. Keyhole gardens were ideal; they require less labour and land size than regular gardens (about 5 x 3 meters), they are prolific, can produce at least 5 varieties of vegetables at a time, require less labour and are easy to maintain, no chemical fertilizer, once built they last 5-7 years with ensured soil fertility, produce vegetables all year round. Keyhole gardens were the flagship of the project, and all participating households produced more than 100% of their vegetable requirements, including increased variety. This success is attributable to the implementation model which comprised: a good institutional framework to support implementation; institutional capacity building; participatory approaches, intersectoral collaboration; involvement of state and none state stakeholders.
MONITORING THE MICRONUTRIENT PROGRAM IN METRO MANILA

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The results of the monitoring of the micronutrient program in Metro Manila depict several challenges in the implementation of the strategies addressing the micronutrient malnutrition in the country. The gains in monitoring the program in highly urbanized Metro Manila may be similar in other urban and rural areas in terms of the issues and concerns encountered by the health service providers.

Micronutrient malnutrition is a serious problem which affects infants, children and women and may lead to serious physical, mental, social and economic consequences. In order to address micronutrient deficiencies, strategies such as micronutrient supplementation, food fortification and dietary diversification are employed by the Department of Health and the local government units. With the decentralized set-up, the implementation of health and nutrition programs was devolved to the local government units while the Department of Health continues to provide technical assistance. In order to ensure an efficient and effective implementation of various health programs at the LGU levels, it is necessary to put in place an appropriate monitoring system. The revised monitoring tool developed by Helen Keller International with CHD OIC and CHD III is piloted in selected barangays in NCR.

The monitoring aimed to determine the overall status of the micronutrient program implementation in Metro Manila. Specifically, this aimed to determine awareness, knowledge and participation of local health workers on the micronutrient programs, needs and barriers to implementation, availability of supplements and IEC materials at the health facilities, proportion of households using iodized salt, proportion of children receiving vitamin A, and consumption and knowledge among children at age 6-7 months.

Monitoring was done in 21 barangays which were selected using the proportionate probability sampling. Twenty (20) households per barangay were sampled using the cluster sampling method. Methods included interviews and record reviews. Data were processed using the SPSS® program and analyzed using the frequency distributions. Eighty-five percent of respondents were women and 15% were men. Among the 715 respondents, 477 are mothers of 6-7 months-old children. Eighty-four health centers were visited for record reviews and 395 health center workers were interviewed. About 60% of the health workers were rated poor in terms of their knowledge on micronutrient functions. Fifty-three percent of the health workers were aware of the policies and guidelines on micronutrient supplementation. Hospital staff were rated poor in terms of knowledge on the functions and policies of the program. Seventy-five percent of health center's health workers have received some input from local officials in terms of their social and transportation.

More than 80% of the 6-7 month old children received vitamin A during the survey. It was noted that 36% of the children were born with zinc and 50% had taken iodized salt. Out of 115 post partum women, 62% were breastfeeding, more than 200 mothers and 62% were taking vitamin A capsules within a month after delivery and 22% were taking iron tablets. Only 22% of the women who fed formula and 32% who fed cow's milk were receiving vitamin A capsules. About 97% of the health centers had administered supply of vitamin A to children 6-7 months. Thirty-nine percent of the health center workers had received IEC materials.

The implementation of the strategies addressing the micronutrient malnutrition in the country. The lessons learned from this study can be used to build effective and efficient health service delivery.

SUCCESS OF VITAMIN A SUPPLEMENTATION PROGRAM IN TANZANIA AND CONTRIBUTION TO CHILD SURVIVAL

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Background: Vitamin A deficiency (VAD) is among the major micronutrient deficiencies affecting children in Tanzania. Vitamin A supplementation (VAS) is used to prevent and control VAD and will remain a key intervention measure until the dietary intake of vitamin A is sufficiently improved through dietary diversification and food fortification. We examined the role of VAS in contributing to the decline in child mortality in Tanzania. Program description: The current twice-yearly national program for VAS began in 2001 for children aged 6-59 months and has been linked with deworming for children aged 12 to 59 months since 2004.

The health system in Tanzania is decentralized and VAS is implemented by the local government authorities (LGAs) with technical guidance and supervision from the national and regional level. Major actions undertaken to increase and sustain high VAS coverage included advocacy with LGAs for increased allocation of resources for VAS, capacity building of LGAs for planning and budgeting for VAS, and social mobilisation and demand creation among communities. Results: Prior to the introduction of the twice-yearly events, vitamin A supplements were distributed through routine services, and achieved a coverage of less than 60%. The twice-yearly VAS program has been highly successful in increasing the coverage of VAS. Coverage is consistently above 65%, and the number of districts that had a coverage of <60% declined from 17 in 2003 to 3 in 2007 following linkage with deworming. Demographic and health surveys showed that the rapid increase in coverage of VAS (by 71%) coincided with a 24% reduction in child mortality between 2000 and 2004. The coverage of a few other health and nutrition interventions increased during the same period, including integrated management of childhood illnesses (54%), use of insecticide-treated nets by children (19%), iron supplementation and oral rehabilitation therapy for children (13%), and exclusive breastfeeding for children aged <6 months (9%). However, the increase in vitamin A supplementation was the most dramatic. Recent analysis estimates that almost 30,000 children can be saved each year in Tanzania if we ensure that every child aged 6-59 months receives a vitamin A supplement twice a year. Conclusion: VAS is contributing to the decline in child mortality in Tanzania. Twice-yearly VAS should continue as strategy to maximise the coverage of VAS until sufficient health service infrastructure can be built to effectively integrate into routine services.
ASSESSING THE SUSTAINABILITY OF ANAEMIA CONTROL PROGRAMS IN GHANA AND MALAWI

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Background: Plausible evidence of sustained implementation and impact of large scale anaemia programs in Sub-Saharan Africa is sparse. Anaemia programs targeting the major preventable causes of anaemia (iron deficiency, malaria, parasitic worms) were implemented in Malawi and Ghana with financial and technical support from World Vision/CDIA and evaluated at the time that external support was ended. The programs showed evidence of effectively integrated programming and reduced prevalence of anaemia. Determining the extent to which these packages of interventions continued to be implemented and their impacts sustained, and documenting the lessons learned from these experiences will provide useful guidance to future efforts.

Aims: To undertake a participatory rapid assessment of the scale and sustainability of implementation and impact of the NMNAH interventions three years after the direct financial assistance ceased.

Methods: Multi-stakeholder assessment teams in each country conducted document review, key informant interviews and focus group discussions at national, district and community levels. Data was collected to assess: 1) current coverage of anaemia-related interventions; 2) level of integration of anaemia control activities within various government ministries and organizations/polices, annual plans, budgets and services; and 3) level of access to knowledge, skills and resources of those involved in anaemia control activities. Five districts and 30 communities were assessed in Malawi and two districts and five communities in Ghana. Stakeholder group meetings were held to review results and reflect on implications for national anaemia control efforts.

Results: National nutrition policies in both countries support anaemia control efforts through a multi-sectoral approach. Coordination is of an ad hoc nature and monitoring of program progress achieved is limited. Disease control efforts (malaria, worms) have increased through special-funded national programs that benefit a large proportion of target groups. National (both countries) and small-scale (Malawi) flour fortification efforts are ongoing. People in former NMNAH project areas clearly articulate the value of iron-rich foods, although production of these foods, including small animals, had not increased overall. Community-based distribution of iron supplements was sustained only in areas with ongoing external support. Project-trained volunteers and health committees remained active and continued to be a valuable support to government-led initiatives.

Conclusions: Sustained anaemia control efforts benefit from policy frameworks but rely heavily on special funding. A critical gap in sustained access to adequate dietary iron was evident and requires increased and focused attention.

IMPLEMENTATION AND PROBLEMATIC ISSUES OF VITAMIN A SUPPLEMENTATION (VAS) PROGRAM MANAGEMENT: LESSON LEARNED FROM CROSS SECTIONAL SURVEY IN 3 PROVINCES IN INDONESIA

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Background: The primary intervention for vitamin A deficiency (VAD)/control in Indonesia is biannual distribution (February and August) of vitamin A capsules (VAS) to under-five children mainly through the national network of integrated health post (Posyandu). Although VAS program has been conducted for three decades still the coverage of the program is low in many areas.

Aims: To generate critical information particularly that related to vitamin A supplementation program’s management and to provide critical actions to improve the program coverage.

Methods: A cross sectional rapid survey was done in three provinces located in three different islands of Indonesia, namely West Kalimantan, Lampung and Southeast Sulawesi to evaluate the program’s performance in February 2007. Each province was represented by five districts (two districts with high coverage and three districts with low coverage based on previous report). Data from the community (i.e children receiving VAC, motivating/de-motivating factors of mothers in attending Posyandu) and program’s provider (i.e. health system assessment to health staff, at provincial, district, sub-district until Posyandu level) were collected.

Results: Coverage of VAS was 56.7% in West Kalimantan, 80.9% in Lampung and 63.1 % in Southeast Sulawesi. Health system assessment results showed that budget allocation for socialization and reaping activities of VAS program in February 2007 were very limited. In most cases, schedule of VAC distribution was informed by cadres or midwives to mothers during Posyandu day one month before VAC distribution (January 2007). Almost all health workers interviewed believed that mothers had been familiar with VAS program, thus no specific and intensive socialization program was needed. However only 30% of mothers gave the correct answer regarding the distribution period and 57.9% mothers responded correctly about the frequency of receiving VAC for their children yearly. Only 19% of mothers got nutrition education about the benefits of vitamin A during VAC distribution. Many expired left over capsules from previous period were also found showing lack of coordination between nutrition unit and pharmacy warehouse in District of Health. There was inconsistency in defining the estimate targeted children. From Posyandu until Provincial Health levels, as well as the number of children who received VAC. Reporting and recording mechanism of VAC distribution by other channels besides Posyandu/health center had not yet been established. Therefore socialization of VAS, capsules logistics and distribution, recording and reporting of coverage and nutrition extension to the community need to be improved in VAS program.

HIGH AND SUSTAINED COVERAGE WITH VITAMIN A SUPPLEMENTS AND DEWORMING TABLETS CAN AND MUST BE ACHIEVED FOR INDIAN CHILDREN. EXPERIENCE AND LESSONS LEARNED IN MAHARASHTRA

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Background: In areas where vitamin A deficiency is prevalent, high and sustained vitamin A supplementation (VAS) coverage can reduce mortality in children by an average 23 percent. The benefits of VAS are further enhanced when VAS is combined with deworming. In the State of Maharashtra, program evidence from Uganda and Nepal was used to advocate for the integrated delivery of VAS and deworming for children under five years old twice yearly. The program - launched in a phased manner - was first implemented in the five tribal districts, then scaled up to 15 districts, and finally to the entire state in 2007.

Aims: The expected outcomes of the program are: 1) Over 80% of children 6-59 months receive vitamin A supplements twice yearly at six-month intervals; 2) 80% of children 12-59 months old receive deworming tablets twice yearly at six-month intervals; 3) the routine immunization program is strengthened by the biannual VAS and deworming program by providing catch-up rounds for immunizing hard-to-reach children.

Methods: UNICEF supported the Government of Maharashtra in developing an integrated plan of action that included among others: procurement and distribution of essential vitamin A supplements and deworming tablets; strengthening the capacity of village health and nutrition workers, developing a comprehensive communication and social mobilization strategy, and implementing a monitoring and evaluation component to document the effectiveness of the program.

Outcomes: In 2006 (1st semester), the VAS with deworming program was implemented in tribal districts and achieved 89% VAS coverage of the targeted child population; in 2006 (2nd semester) the program was extended to 15 tribal districts and achieved 95% VAS coverage; in 2007, the program was implemented throughout the state (including urban areas) and reached 67% and 76% VAS coverage (1st and 2nd semesters respectively). Maharashtra became the first state in India to deliver state-wide VAS and deworming biannually. In 2008, VAS and deworming were integrated into the state’s monthly Maternal & Child Protection Sessions, an acceleration initiative to deliver essential health and nutrition services for children and women, reaching each village monthly on a fixed day and fixed place basis. The reported VAS coverage in 2008 was 72%.

Implications: While programmatic gaps remain – particularly in urban slums - Maharashtra is demonstrating that high and sustained VAS with deworming coverage – reaching out to more than 13 million children - can and must be achieved in India for the benefit of children. Key words not in the title: maternal and child protection sessions, tribal population, urban slums.
BIANNUAL VITAMIN A SUPPLEMENTATION HAS A
POSITIVE IMPACT ON THE SYSTEMS, PROCESSES, AND
COVERAGE OF OTHER CHILD SURVIVAL INTERVENTIONS IN
CHHATTISGARH, INDIA

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Background: In 2005, only 44% of infants were fully immunized and only 13% of children 6-15 months old reported receiving a dose of vitamin A in the previous six months. To improve the coverage of child health services, the Government of Chhattisgarh conceived the Siha Sanrakshan Maah (SSM) or Child Protection Month to be held twice a year in April and October in collaboration with international agencies and local NGOs.

Aims: 1) to improve access to and coverage with an essential package of child health and nutrition services including vitamin A, deworming, growth monitoring, immunization focused on never or partially vaccinated and out-of-date vaccination in households and community feeding centres; 2) to reinvigorate the health system through the periodic review of microplans, coverage targets, achievements and line listing of beneficiaries; and 3) to engage communities actively in health activities.

Methods: Semi-quantitative data from SSM documentation study and from coverage reports and independent surveys have been analyzed. The key indicators measured are: 1) process indicators: cancellation of planned sessions, sessions with list of left outs, drop outs etc); 2) coverage indicators: vitamin A supplementation and immunization coverage, etc; and 3) stakeholder perceptions and other observations.

Results: Processes and outcomes have improved significantly over time (see table below)

<table>
<thead>
<tr>
<th>Round</th>
<th>VAS Coverage</th>
<th>Sessions Cancelled</th>
<th>Sites with line listing</th>
<th>Deworming Coverage</th>
<th>Adequately iodized salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct-06</td>
<td>41%</td>
<td>37%</td>
<td>27%</td>
<td>5%</td>
<td>86%</td>
</tr>
<tr>
<td>Apr-07</td>
<td>35%</td>
<td>36%</td>
<td>40%</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Oct-07</td>
<td>60%</td>
<td>9%</td>
<td>63%</td>
<td>21%</td>
<td>95%</td>
</tr>
<tr>
<td>Apr-08</td>
<td>69%</td>
<td>18%</td>
<td>90%</td>
<td>24%</td>
<td></td>
</tr>
</tbody>
</table>

Community volunteers were present in 70% of sessions monitored and community enthusiasm is evident during SSM months. Coverage evaluation survey (2006) shows 57% of children are fully immunized by 1 year of age.

Conclusions: SSMs show that biannual integrated acceleration initiatives can lead to synergistic increase in coverage, improve health system performance, motivate workers, and create interest in the community. Implications: SSM is being institutionalized in the flagship health (VADP) and nutrition (KDS) programs of the state which assures funding and sustainability and strengthens health systems in progressively addressing social inclusion and equity for the most disadvantaged children. Key words not in title: immunization, equity.
ENHANCING REALISTIC PLANNING AND BUDGETING FOR WICE-YEARLY VITAMIN A SUPPLEMENTATION IN THE CONTEXT OF A HEALTH SWAP AND DECENTRALIZED HEALTH SYSTEM – EXPERIENCES FROM TANZANIA

Background: Development partners are increasingly pooling their financial support in “health baskets” in countries with sector-wide approaches. This has raised concerns regarding the financial sustainability of micronutrient interventions, particularly where the health system is decentralized and the sub-national government authorities have the autonomy to decide how resources are allocated. Following the pooling of donor support for VAS into the health basket in Tanzania in 2007 there were initial concerns that districts would not allocate sufficient resources for VAS and that the VHS high coverage, which is consistently above 85%, would not be sustained.

Aims: To mitigate the impact of new donor funding modalities on VAS coverage and improve the financial sustainability of VAS by developing and promoting the utilization of a computerized planning and budgeting tool (PBT), coupled with advocacy, to facilitate realistic planning and budgeting for VAS in district health plans.

Methods: The PBT was developed through a consultative process involving national, regional and district stakeholders. Government officials from the health departments of all mainland districts were oriented on the PBT prior to the start of the planning and budgeting cycle for the fiscal year (FY) 2008-9. This orientation was combined with advocacy so that officials had the advocacy skills and arguments to defend budgets and ensure that they were included in the district plans. To assess the impact of the PBT and advocate on the allocation of financial resources for VAS we compared the FY 2007-8 and FY 2008-9 VAS budgets.

Results: An excel-based PBT to estimate the financial resources and supplies required annually for VAS was developed and rolled out in Tanzania. The advocacy materials included a fact sheet that provided information on the number of lives saved by twice yearly VAS in every district and region of the country. Follow-up visits with all districts after the submission of their budgets to the national secretariat indicated that over 80% of councils used the tool in developing their FY 2008-9 plans, and the budget allocated per child increased from Tanzanian Shillings 119 to 210 for 2007-8 and 2008-9.

Conclusions: After introduction of a computer-based PBT and accompanying advocacy tools, the resources allocated by districts to support twice yearly VAS in Tanzania increased. The PBT can be adapted for other micronutrient interventions and in other countries with decentralized health systems.

DIFFERENTIALS IN VITAMIN A COVERAGE, SERVICE DELIVERY PATTERNS AND AWARENESS REGARDING VITAMIN A AMONG URBAN AND RURAL COMMUNITIES IN BIHAR HIGHLIGHT NEED FOR DIFFERENT PROGRAMMATIC INTERVENTIONS FOR URBAN AND RURAL AREAS

Background: Since the Alma Ata declaration, primary health care has been a focus in rural areas in India, but not in the rapidly expanding urban areas, especially urban slums. In Bihar, 10.5% of the population is urban with its capital city Patna, home to more than 1.2 million people. Weak urban health infrastructure makes reaching health services such as Vitamin A Supplementation (VAS), a challenge, especially in the urban poor. Since 2004, the government VAS program has targeted pre-school children in both urban and rural settings through a biannual 4 day event: centre-based for 2 days with a house to house approach to cover left outs on the 3rd and 4th days. The reported coverage for the VAS event in 2007 was 97.9%.

Aims: We hypothesized that urban areas significantly differ from rural areas in terms of VAS coverage, service delivery patterns and the Knowledge, Attitude and Practice (KAP) of caregivers. If true, this would have important implications for VAS program planning in urban and rural areas of the state.

Methods: A retrospective cross-sectional field survey was carried out in Dec 07 – Jan 08 in a representative sample of 324 primary caregivers each from rural and urban areas drawn using multi-stage sampling based on cluster sampling methodology.

Results: VAS coverage in urban areas was found to be lower (64% CI: 58.9% - 69.5%) compared to rural areas (77% CI: 72.8%-82.1%). Of those who received a dose in urban areas, only 66% received it from a frontline government health functionary as compared to rural areas where 96% did so. Although caregivers in urban areas were more knowledgeable about the benefits of Vitamin A (31% Vs 44%) than rural caregivers, their awareness of how and where to get a VA dose was significantly lower (60% Vs 71%). Rural caregivers recalled key campaign elements better than their urban counterparts (68% Vs 40%), when prompted.

Conclusions: It is clear that urban and rural areas require different program strategies to achieve universal VAS coverage and improve the KAP of caregivers regarding Vitamin A. Key areas that need attention in urban areas include: improving awareness of, access to and the utilization of, health services. Strategies to address this would include increasing the visibility of neighbourhood booths, involvement of private providers, NGOs and the expansion of Anganwadi centres (Community Nutrition & Pre-school Education Centres) to uncovered areas, especially slums. In rural areas, addressing family planning and service quality among frontline functionaries and educating caregivers regarding the benefits of Vitamin A needs greater focus.

A SUCCESSFUL VOLUNTARY NATIONAL PROGRAM OF OIL FORTIFICATION WITH VITAMIN A IN UGANDA

Background: In Uganda, 28% of children aged 6-59 months, and 52% of women aged 14-49 years have low serum vitamin A, a biomarker of vitamin A deficiency. These high rates of VAD puts children at increased impaired vision, slow recovery from illness, risk of severe infections, and as a result higher possibility of premature death. Vitamin A supplementation during Child Days Plus, dietary diversification, and food fortification have been strategies implemented for the prevention of this deficiency.

Aims: As one of the potential strategies to reduce VAD in Uganda, voluntary fortification of edible cooking oil and fats with retinyl palmitate was started by the country. Coverage and performance is assessed through collection of oil samples at factories, and retail stores around the country.

Methods: Under the National Working Group on Food Fortification (NWGF), the private sector (producers) was educated on the major role of micronutrient deficiencies in health problems, available solutions, and how much it would cost to fortify oil with vitamin A as a public health intervention. As consequence, the largest oil companies adopted vitamin A fortification, and the government committed to advocate for, regulate and monitor the program.

Results: The NWGF was formed, external financial and technical support was sought and the oil industry made a corporate commitment to contribute to public health through voluntary oil fortification with Vitamin A. The country developed a fortification logo, a social marketing strategy, and launched the voluntary program through the media. Due to the wide acceptance of the program, a food control exercise has been conducted to check if the oil is fortified to Ugandan standard. The results indicate that, the oil produced by Mulawa and Bido oil industries is well fortified to levels above 20 mg/kg and their brands cover 85% of market share in Uganda. External investment has been very little, mostly restricted to finance advocacy meetings, trainings, the first blender for one of the industries, and the food control activities carried out by the government.

Conclusions: If the industry structure is right and with a large market share, it can contribute voluntarily with minimum government support. Most fortification expenses, mainly associated to the purchasing of the micronutrients, are transferred into the product price. This case illustrates that some large fortification programs could be implemented in a voluntary base. In the case of oil, direct consumer purchasing of branded products is key for the success.

IMPROVING MICRONUTRIENT SUPPLIES MANAGEMENT IN UGANDA – LESSONS AND CHALLENGES

Aims: To determine bottlenecks in the supply chain for essential micronutrients and related supplies, the A2Z Project and Management Sciences for Health assessed the supply management systems for micronutrients in 6 districts of Uganda. Based on recommendations from this assessment, the A2Z Project supported the Ministry of Health and selected districts to address obstacles along the supply chain to improve access of pregnant women to prenatal iron/folic acid supplements, deworming and malaria drugs.

Methods: Data collected through a 2008 supply chain evaluation showed that IRA stock-outs in 6 districts ranged from 27% -100%, that fewer than 5% of staff responsible for supplies were correctly trained, and only 38% of health facilities use the standardatical Monitoring HMS form to report on supplies. Through advocacy, districts are being engaged to prioritize anemia supplies and strengthen supply systems for micronutrients and anemia reduction medicines through improving communication with service delivery points to ensure availability of supplies at health centers. The Ministry of Health and National Medical Stores are being engaged to address barriers and streamline procedures to ensure acceptable service delivery.

Results: Data on supplies will be used to track stocks and improvements in performance in supplies management nationally and in selected districts and lessons learnt and challenges in stock situation resulting from these interventions will be shared.
**F28** NEPAL ON VERGE OF MEETING ALL THREE MICRONUTRIENT TARGETS OF THE WORLD FIT FOR CHILDREN GOALS

Y. Bhattarai, M. Nathwani, R. Kakshi, M. Mahat


**Background:** The Government of Nepal had adopted the World Fit for Children (WFC) Goals on micronutrients, i.e. to achieve sustainable elimination of Iodine Deficiency Disorders (IDD), control Vitamin A deficiency and reduce the prevalence of Vitamin A deficiency by one third.

**Aims:** To control the high prevalence of micronutrient deficiencies, Universal Salt Iodisation (USI) programme, National Vitamin A Programme (NVAP) and Integrated Anaemia Control Programme (IACP) were launched.

**Methods:** NVAP was launched in 1993, with the main aim to supplement children with Vitamin A capsule twice a year through Female Community Health Volunteers.

In order to control anaemia in children, deworming of 1-5-year children was integrated with the Vitamin A distribution as part of the integrated anaemia control package. The Government is also starting micronutrient sprinkles supplementation of children below two years of age. The IDD programme involves media campaign, IEC merchandising, coordination for improved availability of iodised salt and community-based social marketing campaign in the Eastern & Central Southern Region (accounts one third of the population) where the use of adequately iodised salt is lowest and illegal inflow of sub-standard salt is highest.

**Results:** The Vitamin A supplementation has been highly successful, consistently reaching over 85% of 3.7 million children nationally for 15 years. As a result, the prevalence of Bitot's spots and nightblindness are no longer a public health problem. Also, Nepal is one of the 12 countries on track of meeting the MDG 4 and is going to meet the target well before 2015. Because of an integrated approach including biannual deworming, the prevalence of anaemia in children has gone down drastically from 78% to 40% in the past 5 years. The salt iodisation activities have been successful - a national survey conducted in 2007 found over 95% of households use salt with some iodine and the use of adequately iodised salt has increased from 58% to 77%. The social marketing campaign has increased the use of packed salt from 23% to 54% in the last 2 years in the southern region, and the continuation of the campaign in this region is expected to accelerate the attainment of the USI goal in Nepal.

**Conclusions:** Despite more than 10 years of armed conflict and political instability, Nepal has already achieved the WFC targets on Vitamin A and Anaemia and the current progress in IDD indicates that Nepal will reach the USI goal by 2010. With this, Nepal will be one of few developing countries to have met all 3 WFC targets.

**F29** REACHING OUT TO TRADITIONALLY EXCLUDED CHILDREN. PROACTIVE STRATEGIES ACHIEVE OVER 95 PERCENT VITAMIN A SUPPLEMENTATION COVERAGE IN BIHAR, INDIA

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UNICEF, Patna, Bihar, India

**Background:** Vitamin A deficiency has long been a problem of public health significance in the state of Bihar, with a population of 122 million people. Bihar, the policy of Government of India is to provide nine VAS doses to all children 9-59 months old through the primary health care system and the Integrated Child Development Services (ICDS) program. Over the last years, different strategies have been adopted to reach twice yearly the 13.6 million eligible children, one-third of whom belong to socially excluded groups.

**Aims:** To increase access to and coverage with VAS beyond the levels achieved through routine sustenance and immunization catch-up rounds so as to ensure that over 90 percent eligible children benefit from VAS biannually.

**Framework:** In order to reach universal coverage, all field workers from health and nutrition programs in the 38 districts of the state received joint training on the administration of vitamin A supplements and dietary counseling for improved Vitamin A intake. The first year, a mobile strategy was implemented to ensure that socially and geographically excluded children - traditionally un-reached by health and nutrition programs - benefited from the VAS program. Micro-plans were developed to map out all hamlets located in the extreme periphery. The four-day VAS round included IEC; for social mobilization and community engagement with "re-sites" and "mobile-centres" (Vans). The second year, most hamlets were brought under the government programs, thus reducing the number of hamlets with socially-excluded populations to be targeted. The implementation of additional sites was found to be a better approach than the use of mobile centers. Outcomes: The two strategies were effective in ensuring access to and coverage with up to over 90 percent of the eligible children. However, it was found that outreach through mobile-centers was cost intensive and demanded higher management skills by health and nutrition workers. The additional-site strategy was equally effective, less costly, and hence more cost-effective. As a strategy to further strengthen community involvement, the VAS program became a "people's program" and therefore more sustainable. The mobile-center strategy achieved 95 percent coverage while the additional-site strategy achieved 97 percent coverage.

**Conclusions:** Despite more than 10 years of armed conflict and political instability, Bihar has already achieved the WFC targets on Vitamin A and Anaemia and the current progress in Bihar indicates that Bihar will reach the USI goal by 2010. With this, Bihar will be one of few developing countries to have met all 3 WFC targets.

**F30** STRENGTHENING HEALTH SYSTEMS MANAGEMENT: PREREQUISITES FOR SUSTAINING VITAMIN A SUPPLEMENTATION COVERAGE

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Health Services and Programmes, Luanshya, Zambia

**Background:** In Zambia, Child Health Week is a bi-annual strategy designed as a means of providing Vitamin A to children aged 6–59 months. The Vitamin A supplementation program mode of delivery moved from routine delivery in the Mother and Child Health (MCH) Units to mass distribution conducted twice yearly. Using the National Immunization Days (NIDs) approach in 1997, coverage reached above 90%. The NIDs program allowed for one dose per year but a second dose of Vitamin A supplements was requested in the same age group of children (6–59 months). The bi-annual Child Health Week model was therefore adopted, and has been used within the context of a number of district system factors that have facilitated increase and sustenance of coverage above 70%.

**Aims:** To describe the health systems strengthening factors that have contributed to sustaining high vitamin A coverage and in a cost NIDS setting.

**Framework:** The success factors of high coverage in Vitamin A supplementation stem from two key factors of human resources and financing. Zambia, like other developing countries, faces challenges in staffing levels at health facilities. The use of trained community volunteers in administration and recording of Vitamin A services has enabled the coverage to be increased and sustained above 70% over the years. Over 96% of health facilities rely on community volunteers to administer Vitamin A supplementation during the CHWk. This is done under the supervision of health workers whose primary focus is on vaccinations in this week. In the aspect of health care financing, Zambia’s model of financing is district-based budgeting where resource allocation to programme areas is done by lower levels. Increased use of the multilevel approach mechanism in resource mobilisation since 2004 has enabled a continued investment of districts in Child Health Week. This has helped move the programme from being centrally funded and donor dependent to strong government ownership at district level.

**Recommendations:** To strengthen and sustain high coverage; for Vitamin A supplements supply, there is need to sustain efforts of districts in budgeting and utilizing funds for Child Health Week. Secondly, the use of community volunteers in the provision of Vitamin A supplements should be supported as a practical and cost effective means of delivering CHWk services.

**F31** MILLION VAS DOSES TO ALL CHILDREN 9-59 MONTHS OLD THROUGH THE PRIMARY HEALTH CARE SYSTEM AND THE INTEGRATED CHILD DEVELOPMENT SERVICES (ICDS) PROGRAM.

M. Mwansa, R. Phiri

UNICEF, Lusaka, Zambia

**Background:** In Zambia, Vitamin A supplementation is the driving force for CHWk since it took the place of full immunization coverage. Administered to children 6–59 months; through the integrated bi-annual child health week. This has helped move the programme from being centrally funded and donor dependent to strong government ownership at district level.

**Aims:** To increase access to and coverage with VAS beyond the levels achieved through routine sustenance and immunization catch-up rounds so as to ensure that over 90 percent eligible children benefit form VAS biannually.

**Method:** Two day provincial technical workshops were held for district and provincial staff on data management and trend analysis with a focus on vitamin A supplementation coverage over a period of seven years. A total of nine workshops were held and the Vitamin A trends were shown by provinces in subsequent CHWk rounds improved in terms of completeness and accuracy. Furthermore, the national Vitamin A supplementation coverage increased from around 79% to above 90%.

**Results:** It was observed that after the provincial trainings on data analysis, the quality of data reported by provinces in subsequent CHWk rounds improved in terms of completeness and accuracy. Furthermore, the national Vitamin A supplementation coverage increased from around 79% to above 90%.

**Conclusions:** Strengthening data management and analysis with a focus on Vitamin A supplementation yielded good results by exposing provincial and district staff to data trends and providing a basis for comparison of performance between districts and provinces. The heightened awareness and capacity development resulting from the training may also have contributed to the increase in Vitamin A Supplementation coverage for all the districts and provinces observed in the subsequent CHWk.
LESSONS LEARNED IN SCALING-UP MATERNAL AND CHILD HEALTH AND NUTRITION ACTION WEEK IN CAMEROON

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1Ministry of Public Health, Yaoundé, Cameroon, 2Helen Keller International, Yaoundé, Cameroon, 3Plan Cameroon, Yaoundé, Cameroon

Aims: Identify lessons learned while scaling up Maternal and Child health and Nutrition action week Framework: During the month of July 2008, Maternal and Child health and Nutrition action week will be organized throughout the country. The package of interventions involved: Vitamin A supplementation of children and post partum women, deworming of infants, polio immunization, tetanus vaccination of women at child bearing age in 10 health districts and for pregnant women, routine immunization, administration of intermittent preventive treatment to eligible pregnant women and behaviour change communication focusing on exclusive breastfeeding. Data were collected using tally sheet and Outcomes and lessons learned will be shared during the forum.

ACCELERATION OF VITAMIN A SUPPLEMENTATION THROUGH CHILD HEALTH WEEKS IN OGUIN AND OSUN STATES OF NIGERIA

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Background: In Nigeria, vitamin A deficiency (VAD) continues to be a public health problem in Nigeria as it contributes to infant and child mortality. The phasing out of the National Immunization Days (NIDs) in Nigeria led to the adoption of the Child Health Week (CHW) strategy with an objective to contribute to reduction in morbidity and mortality in Nigerian children, through large-scale cost effective vitamin A supplementation. In partnership with the State Governments, Micronutrient Initiative, BIF, and other partners in the health system, the CHW strategy was implemented between 2007-2008 in Ogun and Osun States with initial target coverage of 70%. The intervention involved effective partnership building by BIF with state and local governments and other stakeholders, training of health workers, social and community mothers mobilization, distribution of Vitamin A capsules, effective supervision, data collection and report writing.

In the first round of Vitamin A Supplementation (VAS) in 2007, 598,697 (90.0%) of 668,699 children (6-59 months) and 577,383 (90.0%) of 671,566 children (6-59 months) were supplemented in Ogun and Osun States respectively while in the second round of 2007, 647,902 (105.0%) of 616,237 children and 446,059 (71.1%) of 617,506 children were supplemented with vitamin A in Ogun and Osun States respectively. Using the new Nigeria census figures, the 2008 first round of VAS witnessed an increased turnout of 712,832 (112.6%) of 654,307 children (6-59 months) and 893,166 (125%) of 744,691 children (6-59 months) in Ogun and Osun States respectively were supplemented. For the 2008 second round of VAS, 604,579 (92.4%) of 654,307 children (6-59 months) and 517,437 (72.4%) of 744,691 children (6-59 months) in Osun and Ogun States respectively were supplemented. This drop in coverage was due to the support of WHO/UNICEF/HR/PLAN, the week was scaled-up at national level in July 2008 so as to enable the country move progressively towards the achievement of the millennium development goals by offering twice yearly an integrated package to alleviate maternal and child morbidity and mortality.

Aims: identify lessons learned while scaling up Maternal and Child health and Nutrition action week Framework: during the month of July 2008, Maternal and Child health and Nutrition action week will be organized throughout the country. The package of interventions involved: vitamin A supplementation of children and post partum women, deworming of infants, polio immunization, tetanus vaccination of women at child bearing age in 10 health districts and for pregnant women, routine immunization, administration of intermittent preventive treatment to eligible pregnant women and behaviour change communication focusing on exclusive breastfeeding. Data were collected using tally sheet and Outcomes and lessons learned will be shared during the forum.

DETERMINANTS OF COMPLIANCE TO ANTENATAL MICRONUTRIENT SUPPLEMENTATION AND WOMEN’S PERCEPTIONS OF SUPPLEMENT USE IN RURAL NEPAL

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Background: Antenatal iron-folic acid supplementation programs in developing countries have failed to be successful, frequently reporting low coverage rates and compliance. And yet, the global public health community is moving towards antenatal multiple micronutrient supplementation strategies in settings where micronutrient deficiencies are common and co-exist.

Aims: We examined factors affecting compliance to supplementation and women’s perceptions of supplement use in the context of a micronutrient supplementation trial among pregnant women in rural Nepal.

Methods: In early pregnancy each of 5 alternative combinations of micronutrients during pregnancy through 3 postpartum. They were visited twice a week to monitor compliance and to replenish tablets by female workers. At 3 mo postpartum women with live births (n=4096) were interviewed regarding perceptions of the supplement. Median compliance was calculated as percent of total eligible doses received by women and was high (84%) and did not differ by treatment group.

Results: Women with high compliance (>84%) were likely to be older, less educated, poorer, undernourished, belonged to lower caste and of Pahadi (Hill) ethnicity compared to women with low compliance (<68%). Smoking and drinking alcoholic in the past week during pregnancy were associated with low compliance. The major reason for irregular intake was forgetting to take supplements. A higher proportion of the compliers liked taking the supplements but only half of them were willing to purchase them in the future. A large proportion of women (91%) perceived a benefit from taking the supplement such as improved strength and health, whereas only around 10% perceived any adverse health-effect. Less than 5% of women considered the supplement to cause harm by increasing the size of the baby. GI side effects were not a major barrier to compliance. Women who reported resuming taking supplements after being counselled regarding side-effects were more likely to have high compliance than those who gave up taking the supplements.

Conclusions: This analysis highlights that poor, undernourished, uneducated women can have high compliance to antenatal supplementation if they are suppled with the tablets and reminded to take them regularly, and counseled about side-effects. Funded by the Ofc of Health, Inf Dis and Nutrition, USAID. (Washington DC, The Bill and Melinda Gates Foundation, Seattle, WA, & The Sight and Life Research Institute, Baltimore, MD).

QUALITY ASSESSMENT OF HIGH DOSE VITAMIN A CAPSULES USED IN GLOBAL VITAMIN A SUPPLEMENTATION PROGRAMS

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Background: For >10 years, the Micronutrient Initiative (MI), with funding from the Canadian International Development Agency (CIDA), has procured and donated >1.5 Billion soft gel vitamin A capsules (VACs) through UNICEF to public health programs. MI ensures that the VACs are manufactured according to strict specifications set by WHO/UNICEF/MI, and that appropriate quality assurance is undertaken before, during and after production, prior to shipment. However these measures alone cannot guarantee effective performance in field conditions, so it is also necessary to access periodically the residual retention of VACs that have been exposed to real field conditions on a large scale, especially where storage conditions may be less than optimal and many other factors affect them that are difficult to simulate in a lab.

Aim: To assess whether 95% of VACs, in the field still within their shelf life are within the U.S. Pharmacopoeia specification for VACs (95.0-120.0% of the stated label claim for vitamin A).

Methods: A sampling framework was developed, peer reviewed and used to request bottles of VACs (still within their expiry dates) from countries with hot and humid climates as a representative sample for independent laboratory analysis by HPLC. A sample that contained <95% or >120% of the labelled amount of vitamin A was considered sub-optimal.

Results: 642 bottles of 100,000 VACs (blister) were requested from the field, 279 were received and 211 were eligible for assay (within shelf life & from the lot of samples requested). Two hundred and ten out of 211 samples were found to be within specification (point estimate 99.2%, 95% CI: 97.3, 97.3) with a minimum retinal value of 85.0 IU, maximum of 111,271 IU and median of 104,320 IU. For the 200,000 VACs (red), 346 bottles were requested from the field, 320 were received and 200 were eligible for assay. Sixty seven out of the 200 samples were found to be within specification (point estimate 95.2%, 95% CI: 90.4, 100.0). The minimum retinal value for this product strength was 186,124 IU, maximum was 217,067 IU and the median was 204,985 IU.

Conclusions: The results provide strong assurance that the VACs donated by MI for VA supplementation programs reliably maintain their expected effectiveness in field conditions for their stated shelf life. They also suggest that the current specifications and quality assurance protocols are effective and should continue to be applied for all procurement of high dose VACs for public health programs. The results also underscore the plausibility of the mortality reduction impacts commonly attributed to VAS programs globally.

EVIDENCE-BASED PROGRAMS
**F36** 
**DESIGNING RIGOROUS EVALUATIONS FOR COMPLEX, MULTI-FACETED NUTRITION PROGRAMS: AN EXAMPLE FROM THE INTEGRATED CHILD DEVELOPMENT SERVICES (ICDS) PROGRAM IN INDIA**

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**Background:** Generating evidence on what impact complex programs have on nutrition and micronutrient (MN) outcomes, and of how that impact is achieved, is crucial for policy decisions. Building such evidence is challenging when program designs are complex and include multiple interventions and thus, different pathways of impact. Similarly, for political, ethical and logistical reasons, large-scale program roll-out is often based on poverty ranking and does not allow randomization or stepped wedge implementation. This complicates identification of a valid comparison group. In such cases, evaluations need to rely on non-randomized designs and appropriate statistical and econometric techniques, and compare program “add-ons” and innovations rather than use pre-randomized designs. Assessment of program processes is particularly important in such designs to capture data on impact and process pathways.

**Aims:** We describe the process used to: 1) design a state-of-the-art impact evaluation plan for a complex, on-going program implemented at scale; and 2) identify and assess the pathways through which program add-ons were implemented and used by program beneficiaries. This is done in the context of an evaluation for World Bank support to the ICDS program in 8 states in India. The ICDS program, the largest of its kind worldwide, has a supplementary feeding component, and some states also include MN interventions such as Sprinkles. Through links with the health sector, the program also provides micronutrient and multivitamin distribution and iron supplementation to the ICDS program in 8 states in India. The evaluation was done in the context of an evaluation for World Bank support to the ICDS program in 8 states in India.

**Methods:** 1) Consultation with funding and implementing bodies to identify non-randomized designs; 2) Review of previous ICDS reports, evaluation data and existing sampling frames, and identification of data needs for specific non-randomized designs to develop valid counterfactuals and survey sampling frames; 3) Development of program theory framework to identify main aspects of impact pathways and program operations and utilization. 4) Telephone interviews and review of prior evaluation reports to assess local institutional capacity.

**Results & Conclusions:** The process of designing impact and process evaluations for complex programs requires consideration of multiple perspectives and a good understanding of program operations. The use of program theory in a consultative manner to lay out impact and process pathways is recommended as it facilitates understanding of implementation needs, and allows tailoring of pathway assessment to different implementation scenarios.

**F37**

**ENSURING SUSTAINABILITY OF AN INTEGRATED ANEMIA PREVENTION AND CONTROL PROGRAM THROUGH SOCIAL MARKETING**

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**Background:** A recent cross-sectional study identified mild to moderate anemia prevalence among 6-36 month old children and non-pregnant, non-lactating women of reproductive age in two provinces of the Philippines: Eastern Samar and Isabela. Social marketing strategies were formulated to promote the provincial integrated anemia prevention and control plans developed for each province and to ultimately contribute to the reduction of anemia prevalence in said provinces.

**Aims:** The study aimed to identify current knowledge, attitudes and practices (KAPs) on anemia of program beneficiaries and service providers that were used to identify entry-points for the social marketing of the integrated anemia prevention and control plans. It also lays down the social marketing mix developed given the provinces’ anemia situation and KAPs.

**Methods:** KAPs were determined through the conduct of survey (n = 537 and n = 554), 23 focus group discussions, 24 key informant interviews and two consultative meetings. One for the consumers (program beneficiaries) and the other group for service providers in the two provinces.

**Results:** Knowledge on anemia, its causes, consequences, and intervention for its prevention and control were found inadequate in the two groups. Prevailing anemia-related attitudes and practices contributed to the serious anemia situation. Specific problems identified included: a) perception of anemia as non-life threatening disease; b) poor compliance to iron supplementation; c) poor awareness of iron deficiency anaemia; d) poor understanding of programs; d) perceived non-sustainability and lack of effectiveness of programs; e) no sense of ownership of national programs; f) problematic values among beneficiaries; and g) lack of support for programs.

**Conclusion:** Responding to these issues, using the 5 Ps of social marketing, the following mix of strategies were recommended: 1) Products - iron supplements, iron fortified foods (i.e., rice, bread, processed foods) should be affordable, safe, and of acceptable taste; 2) Price - products are preferred free of charge by the target groups; 3) Place - the barangay (village) health centers, boulangeries (bakery), pharmacies, and sari-sari stores (local/smaller versions of mom and pop stores) were mentioned best for distributing anemia commodities; 4) Promotion - this should be thorough and geared to products endorsed by popular but credible celebrities, and 5) Politics - local chief executives to effect political will that hopefully will address anemia and support the integrated plan.

**F38**

**OPPORTUNITIES AND CHALLENGES TOWARDS DEVELOPING AN INTEGRATED ANEMIA PREVENTION AND CONTROL PROGRAMME: INSIGHTS FROM TWO PHILIPPINE PROVINCES**

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**Background:** The recent anemia situational analysis conducted in two provinces covered by UNICEF’s Country Programme for Children (CPC) in the Philippines identified anemia as a public health concern among 6-54 month old children and non-pregnant, non-lactating women of reproductive age (WRA). Results revealed the multi-factorial causality of the problem and the need for an integrated approach for anemia prevention and control.

**Aims:** To identify opportunities and challenges for planning and implementing an integrated plan for anemia prevention and control for the provinces of Eastern Samar and Isabela.

**Methods:** Key informant interviews (n = 48) and focus group discussions (n = 24) of various stakeholders at the national and sub-national (provincial, municipal and village) were conducted to assess existing and prospective interventions. These were complemented by a survey among caregivers of 6-36 month old children (n = 530) and WRA (n = 559) on anemia knowledge, perception and practices (KAPs), and two provincial consultations/ planning workshops.

**Results:** Standard interventions (iron supplementation, food-based approaches such as food production, food fortification, dietary diversification, and public health measures) exist in the provinces. However, these are not implemented in an integrated manner. The opportunities include the presence of a strong governmental will to develop and implement an integrated program on anemia, local chief executives who recognize the importance of making investments in nutrition in general, and continuing demand from target groups for services to prevent and control anemia. However, the challenges include low awareness and utilization of services among target beneficiaries, which in turn explain poor compliance to the iron supplementation regime, low knowledge on planning and implementing interventions particularly targeting the most at-risk groups and selecting interventions among service providers, and existence of different evaluation systems on nutrition and health which add to the confusion in feedback.

**Conclusion:** Existing interventions and commodities at the provincial level are inadequate in addressing anemia. There is a need for new interventions but integration of interventions into one program and incorporating creative and innovative strategies to increase consumer utilization and satisfaction are necessary. To ensure sustainability, stakeholders’ cooperation and support of the ICDS are similarly critical.

**F39**

**TANZANIA VITAMIN A SUPPLEMENTATION: COMPARISON OF BI-ANNUAL ROUND ESTIMATES WITH TALLY SHEET, PROGRAM SURVEY, AND DHS DATA**

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**Background:** Vitamin A Supplementation (VAS) in Tanzania was introduced in 1987 as an essential drug for the prevention and treatment of Xerophthalmia and became a part of the EPI program in 1997. Since 2001, bi-annual VAS rounds have been instituted for all children 6-59 months of age.

**Aims:** Review VAS coverage rates by source of data to assess data quality from different sources and the factors affecting data quality.

**Methods:** Review variation in VAS coverage rates from 3 sources: tally sheet-based data for the June 2004 round of the twice yearly VAS program; the MOST/HKI population-based assessment of July to August 2004, and the Tanzania DHS conducted from August 2004 to February 2005. Results: Tally sheet-based and program survey data show consistent and high VAS coverage rates between 80% and 95% with limited variability across districts and regions. The 2004/05 DHS reports a much lower coverage, 46%, with significant variation by region. Region by region comparison shows consistency between tally and program survey data but marked inconsistencies with the DHS data. Preliminary analysis suggests that implementation errors, such as not showing a diversity of samples of the vitamin A capsules to respondents and using ‘child read to health’ cards to verify VAS records, during the DHS resulted in an underestimate of coverage. Timing and questionnaire differences of the DHS appear to have also influenced accuracy.

**Conclusions:** VAS coverage surveys must be carefully designed and implemented to accurately capture and provide VAS coverage estimates that can be used as valid comparison data for determining coverage trends. Ideally, multiple data sources should be analyzed and compared to ascertain the best estimate. It remains important for the caregiver of the target child to be shown the actual vitamin A capsule to trigger the memory accurate when estimates are taken after the VAS round. Also, confirming respondent’s recall with ‘road to health card’ records should be avoided in situations when the rate of recording is very low. If multiple interventions are provided during the round and health providers are not explicit about the services provided, the caregiver may not be able to identify vitamin A supplements without a visual cue. This suggests the importance of having health providers routinely identify the services provided during the round and illustrates their enhanced role for behaviour change communications in obtaining more accurate coverage estimations after the bi-annual VAS round.
F40 BARRIERS TO ACHIEVING NATIONAL VITAMIN A COVERAGE: LESSONS LEARNED FROM UGANDA

Background: Since 2004 Uganda has been implementing bi-annual child days plus (CDP) to provide Vitamin A (VA) supplements to children 6-59 months. Implementation is at the district and sub-district level through health facilities, schools and community outreaches building upon the routine health service delivery system. The national target for VA coverage is 80%, but unfortunately it has not been achieved despite significant efforts to put in place mechanisms, guidance, structures and resources. The bulk of the problem is born by delayed micro planning for VA supplementation at district and sub-district levels, leading to poor social mobilization, late procurements of supplies, and insufficient resources mobilized.

Aims: To determine the underlying cause of the fluctuating performance in vitamin coverage. The hypothesis is that early micro planning enhances extensive implementation which yields higher VA coverage, and similarly, accurate and complete reporting of results produces valid and reliable VA coverage.

Methods: Rapid assessment procedure was used to identify VA supplementation barriers. This included quantitative methodology to review coverage data from 12 districts. A qualitative analysis was conducted of existing CDP reports, field supervision reports for the programmatic context at the implementation levels, and in-depth interviews with CDP planners and service providers to determine their perspectives of the challenges of Vitamin A supplementation.

Results: System and structural barriers to success in Vitamin A coverage identified were 1) lack of early planning and budgeting for CDP at the district level; 2) lack of advocacy for resource allocation for CDP; and 3) poor quality of data recording and reporting due to the absence of system for validation or verification of data consistency.

Conclusions: Increases in Vitamin A coverage are proportional to improvement in early micro planning and budgeting for CDP. Enhancing data quality checks and controls at the point of data source and aggregation will increase the reliability and accuracy of the Vitamin A coverage results from the CDP.

F41 CHALLENGES OF USING HMIS TO MONITOR VITAMIN A COVERAGE: THE CASE OF UGANDA

Background: For many years Ministry of Health has used the Health Management Information System (HMIS) as the official reporting structure for health services from the health unit through the district to the central resource center. HMIS captures vitamin A supplementation data for children visiting health units for clinical services and child days. The Ministry, in an attempt to improve VA reporting, introduced a parallel reporting structure involving use revised tally sheets and district summary reports that were only used during child days. Efforts to capture and report VA supplementation data are hampered with numerous huddles; such as existence of multiple data collection tools, untrained health workers capturing data, delayed reporting, and lack of data validation.

Aims: To improve the quality of vitamin A coverage data captured at health units or during child days. The hypothesis is that an effective HMIS can be utilized to capture accurate and timely vitamin A coverage data.

Methods: A comparative analysis of the vitamin A data captured over successive rounds was conducted between HMIS reported VA data and tally sheet reported VA data to assess its appropriateness in monitoring national VA supplementation indicators.

Results: The tally sheet and summary reports recorded and reported a lot more VA data compared to standard HMIS tools across the 5 study districts. Health workers were more likely to report more accurately and larger numbers using the revised tally sheets than the HMIS forms. Below is a comparison of VA reported data HMIS tool Vs tally sheet in 5 sample districts.

<table>
<thead>
<tr>
<th>Number of children given Vitamin A</th>
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<tbody>
<tr>
<td>District tally sheet data</td>
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<tr>
<td>District HMIS data</td>
</tr>
<tr>
<td>Adjumani</td>
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<tr>
<td>Arua</td>
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<tr>
<td>Bogot</td>
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<td>Bungoma</td>
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Conclusions: Re-orienting health workers in use of HMIS for capturing and reporting VA data and implementing quality control checks significantly improves the volume of data reported. Ministry of health should continuously review VA data tools and audit data quality in order to enhance the volume and quality of data reported.

F42 FERRIC SODIUM EDTA AND ITS LONG AND WINDING ROAD TOWARDS IMPLEMENTATION AS A FOOD FORTIFICANT.

Background: Since a number of decades ferric sodium EDTA (Fella-EDTA) has been known as a strong tool in fighting iron deficiency anemia (IDA). Why does its implementation into food fortification take so long? Possibly insight in the historic developments of Fella-EDTA as an iron fortificant might provide a clue?

Aims: The earlier and broader implementation will take place, the more people will benefit.

Methods: Literature search and market contacts

Results: The first indications of Fella-EDTA being a safe and useful source of iron for humans dates back from the 1950s. In the 1970s it become clear that Fella-EDTA is particularly efficacious in diets characterized by a high phytate content as prevailing in many developing countries. The next step was approval of Fella-EDTA as a food fortificant by accumulating sufficient evidence for its safety. This took another two decades until finally in 1999 JECFA declared that “sodium iron EDTA could be considered safe when used in supervised food fortification programmes . . . ”. A request of ILSI in 2000 to Akzo Nobel triggered the development of food-grade Fella-EDTA (“Ferrazone”).

After 2006 field trials in China, Vietnam and Kenya have strengthened the evidence for Fella-EDTA as a highly effective tool to combat IDA.

In 2006 FAO/WHO issued guidelines on food fortification with micronutrients, in which Fella-EDTA is advocated for high-phytate flours and sauces with a high peptide content. In 2007 JECFA re-evaluated the safety of Fella-EDTA and stated that “sodium iron EDTA is suitable for use as a source of iron for food fortification to fulfill nutritional iron requirements . . . ”. This statement confirms that JECFA now regards Fella-EDTA as an iron fortificant with a safety profile that is not different from the existing, commonly used iron fortificant like ferrous sulfate, ferrous fumarate, etc.

Conclusions: A detailed analysis of all the historic developments of Fella-EDTA reveals that its recognition as a fully safe iron fortificant has only been finalized in 2007. This may have been the major cause of its delayed implementation into staple foods like wheat and maize flour.
**ABSTRACTS**

**F43 INTERLEUKIN-10 AND INTERFERON GAMMA IN PREGNANT ADOLESCENTS WITH MICRONUTRIENTS DEFICIENCIES**

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The micronutrient deficiencies are public health problem in developing countries that influences on the health of pregnant women and the growing fetus and newborn. There are studies that show immunology of pregnancy, has been heavily influenced by Th1/Th2 cytokine paradigm. However, there are no studies about changes the serum concentration of cytokines in adolescent pregnancy with multiple micronutrient deficiencies.

**Aim:** To analyze Interleukin-10 (IL-10) and Interferon-gamma (IFN-γ) in pregnant adolescents with micronutrients deficiencies. Subjects and Methods: We studied 211 female adolescents. Non Pregnancy (NP) (n=77; 15.9±1.20 y old) and Pregnancy (P) (n=14, 17.2±1.46 y old), of a low socioeconomic condition. Adolescents with a positive C reactive protein were excluded. The following parameters were measured: a) Anemia was defined as a hemoglobin level less than 120 g/L in NP adolescents, <110 g/L in the first and third trimester or less than 105 g/L in the second trimester of pregnancy. b) Serum retinol was determined by HPLC using the Bioanalytical method. international reference standards were considered to define VAD (serum retinol < 20 microg/dL), risk of VAD (20-30 microg/dL) and vitamin A sufficiency (>30 microg/dL). And c) Serum concentrations of interleukine-10 (IL-10) and Interferon-gamma (IFN-γ) were determined by an ELISA method (pg/mL). The data were analyzed using the SA-STAT statistical program; the results were presented as mean ±SE. Standard deviation and percentage. The differences between mean values were analyzed by T student and ANOVA test.

**Results:** Prevalence of anemia in female adolescents was 52.38% (P (70.25%); NP (29.75%)); prevalence of iron deficiency anemia (IDA) was 40.68% (P (63.25%); NP (16.36%)). Pregnancy Adolescents showed a significant increase of IL-10 (p<0.0001) and a significant diminished of IFN-γ serum concentration (p<0.01) except non pregnancy adolescents. No significant association was observed between cytokines and gestational age, anemia or VAD. Conclusion: Our results showed that successful pregnancy is a IL-10 diminished phenomenon, while that Th1 cytokines, particularly IFN-γ, are incompatible with successful pregnancy. However, it is unclear whether anemia and VAD, generated the problems or are secondary responses to failure of other mechanisms. Although, multiple micronutrient supplementation could be used as an approach to combat maternal deficiency and to improve reproductive health outcomes.

**F44 NUTRITIONAL STATUS OF IRON, ZINC AND COPPER IN HELICOBACTER PYLORI INFECTED CHILDREN FROM BUENOS AIRES, ARGENTINA. ITS RELATIONSHIP WITH BACTERIAL GENOTYPE**

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**Background:** Helicobacter pylori infection is the major etiologic factor in the development of chronic gastritis and peptic ulcer disease. H. pylori has been related to iron deficiency anemia (IDA) and other micronutrient deficiencies. Clinical outcome of the infection was reported to be influenced by bacterial virulence genes CagA and VacA, among other factors. However, the role of H. pylori genotypes in the development of micronutrient deficiencies has not been established.

**Aims:** To determine the prevalence of H. pylori infection in asymptomatic children from Buenos Aires, Argentina, and to evaluate the relationship between bacterial genotype and iron, copper and zinc nutritional status.

**Methods:** A total of 305 children referred with upper gastrointestinal symptoms were evaluated for the presence of H. pylori by the 13C-Urea Breath Test. Bacterial genotype was determined from bacterial biopsy specimens. Copper and zinc serum levels were measured by atomic absorption spectrometry, serum ferritin levels (SF) by an immunoenzymatic assay and hemoglobin by an automatic hematocrit counter. Iron deficiency (ID) was defined by ferritin values <15 µg/L, and anemia by hemoglobin values <11.5-12 g/dL, according to age. Soluble transferrin receptors (TfR) were measured as a measure of functional iron deficiency. H. pylori CagA/VacA genotype was evaluated by Polymerase Chain Reaction. Statistical analysis was performed by Linear and Logistic regression, the Fisher Test, Student’s test and Mann Whitney Test.

**Results:** A total of 16 children (23.4%) were H. pylori positive. It was observed in 14.2% and 11.6% in the H. pylori positive and negative group. Prevalence of anemia was 12.0% for the positives, and 8.9% for the negatives. No association was found between H. pylori infection and anemia, nevertheless H. pylori infection was a decrease of 0.60 µg/L (95% CI: 15.77 to -1.80) in serum ferritin levels compared to non-infected children. However no association was found between H. pylori infection and TfR. Nutritional status of zinc was not associated to H. pylori infection, although bacterial genotype was not involved in this relationship.

**F45 THE EFFECT OF THE ACUTE PHASE RESPONSE ON INDICATORS OF VITAMIN A AND IRON STATUS IN PRESCHOOL CHILDREN**

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**Background:** Acute phase response (APR) has significant effect on indicators of vitamin A (VA) and iron status, serum retinol and serum ferritin (FT), which possibly resulting in misclassification of VA and iron status.

**Objectives:** To estimate the effect of APR on indicators of VA and iron status in preschool children.

**Methods:** About 385 preschool children from 4 kindergartens in research sites were selected to measure the concentration of serum related to HPSL, serum ferritin by ELISA, hemoglobin by hemoglobin-cyanide method and C-reactive protein (CRP) by immunoturbidimetry to analyses the correlation among these indicators to explore the effect of APR on nutritional status.

**Result:** The concentrations of hemoglobin, serum retinol and FT of children with CRP >10 mg/L and CRP <10 mg/L were (11.6±0.55 mg/L) and (11.3±0.51 mg/L); (1.20±0.30 mg/dL) and (1.27±0.20 mg/dL); (23.95±14.60) µg/L and (23.37±16.10) µg/L, respectively. There is no significant difference of the hemoglobin status between the subjects with different CRP level. Serum ferritin concentration were significant lower in subjects with elevated CRP that in subjects with normal CRP, while the status of FT is contrary to this. Prevalence of inadequate vitamin A in subject with elevated CRP level was obviously higher than that in subjects with normal vitamin A (P<0.05). The prevalence of inadequate vitamin A was 34.04% with 1.56% subjects with elevated CRP level and the percent of normal iron storage was 53.25% with 3.12% subjects with elevated CRP level.

**Conclusion:** The APR can significantly affect serum retinol and FT. Simultaneous measurement of CRP will improve the assessment of micronutrient status.

**F46 PREVALENCE AND PREDICTORS OF IRON DEFICIENCY IN FULLY BREASTFED INFANTS AT 6 MO OF AGE: COMPARISON OF DATA FROM 6 STUDIES**

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**Background:** Iron deficiency can occur among exclusively breastfed infants before 6 mo of age in susceptible populations.

**Objectives:** To determine whether subgroup of fully breastfed infants may be at risk of iron deficiency prior to 6 mo.

**Methods:** We compared the prevalence of low plasma ferritin concentration (<12 µg/L) and iron deficiency anemia (IDA; ferritin <12 µg/L), and Hb < 105 g/L) and assessed the potential risk factors associated with iron deficiency and IDA at 6 mo among 404 infants in 6 different studies in Ghana, Honduras, Mexico and Sweden who had a birth weight > 2500 g and were fully breastfed. Infants with elevated C-reactive protein concentration (8%) were excluded.

**Results:** The percentage of infants with low ferritin was 6% in Sweden, 17% in Mexico, 13-25% in Honduras and 12-17% in Ghana. The percentage with IDA was 2% in Sweden, 4% in Mexico, 5-11% in Honduras and 8-16% in Ghana. With data pooled from all studies, the key predictors of low ferritin (20% overall) were immediate umbilical cord clamping (AOR 4.5 [1.9, 11.0]), male sex (AOR 4.0 [2.2, 7.3]) and birth weight between 2500 - 2999 g (AOR 3.7 [1.3, 10.0]). The predictors of IDA (8% overall) were male sex (AOR 7.2 [4.2, 11.6]), birth weight between 2500 - 2999 g (AOR 3.0 [1.4, 6.0]), weight gain since birth above the median (AOR 3.1 [1.2, 7.9]) and immediate cord clamping (AOR 3.7 [0.8, 16.5]). The combination of birth weight 2500-2999 g or male sex was 91% sensitive for identifying iron deficiency and 97% sensitive for iron deficiency anemia.

**Conclusion:** These variables could be used to identify which fully breastfed infants are at risk of iron deficiency or iron deficiency anemia before 6 mo.
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Background: There is limited information on: 1) the concentration of zinc in breast milk of mothers in lower income countries at different times post-partum; 2) the total amount of zinc transferred from mothers to infants of different ages in these settings through breast milk; and 3) whether zinc transfer from mother to infant differs among appropriate-for-gestational-age (AGA) and small-for-gestational-age (SGA) infants.

Aims: 1) To measure breast milk and zinc transfer from mothers to infants, using the deuterium-to-mother technique, in mothers of AGA and SGA infants. 2) To measure the breast milk zinc content and serum zinc in both the mother and infant.

Methods: Forty mother-infant pairs have been recruited to date, 21 AGA infants and 19 SGA (recruitment is still on-going). Gestational age was assessed by ultrasound at enrolment and on day 0, blood and saliva samples were collected from mother-infant pairs and deuterium was given orally to the mother. Subsequently, saliva samples were collected on days 1, 2, 3, 4, 13, and 14 from infants and on days 1, 2, 3, 13 and 14 from mothers. Breast milk samples were collected on day 0 and 4 in each round for analysis of zinc concentration. Plasma and milk zinc was analyzed by Atomic Absorption Spectrophotometry.

Results: Mean birth weight and length was 3.0 ± 0.2 kg and 48.7 ± 1.0 cm for AGA and 2.4 ± 0.4 kg and 46.8 ± 1.8 cm for SGA infants. Maternal serum zinc concentration was 3.55 ± 0.3 mg/L, among mothers of AGA infants and 0.60 ± 0.3 mg/L, among mothers of SGA infants at 4 week post-partum (p=0.04), but there were no differences between groups of women at 12 and 24 weeks. Infants’ mean serum zinc concentration did not differ between AGA and SGA infants at any time point. Breast milk zinc concentration decreased significantly with infant age (2.59 ± 0.8, 1.50 ± 0.5, 1.10 ± 0.4 mg/L at 4, 12 and 24 weeks respectively; p=0.000), but did not differ among mothers of AGA and SGA infants. Analysis of breast milk volume and milk total zinc transfer are underway.

Conclusions: Results for milk zinc concentration are consistent with published data, and do not appear to differ for mothers of AGA and SGA infants. Information on milk zinc transfer will be reported.

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Background: Vitamin A deficiency remains an ongoing problem yet to be resolved in many low income countries. Moreover, vitamin A deficiency continues to be a major contributing factor to infant morbidity and mortality. A result of this, many vitamin A supplementation programs exist. However, much research still needs to be done to successfully optimize these programs. Consequently, we have undertaken scientific investigations towards this end.

Aims: Specifically, we have investigated how dietary fat intake influences the metabolic pathways through which vitamin A is absorbed, metabolized and stored in the body of an animal model. Our long-term goal is to identify the optimal amount of dietary fat needed to bring about maximal vitamin A uptake and storage, while limiting potentially excessive fat accumulation.

Methods: We fed diets containing different levels of vitamin A and fat for a period of 4 weeks. Liver, serum samples and adipose tissue samples were then collected for high performance liquid chromatography (HPLC) analyses for determination of vitamin A levels and for measurement of triglyceride content using a standard colorimetric assay. Data were analyzed statistically to identify significant outcomes.

Results: High fat diets were found to have a marked effect on the amount of vitamin A stored in the liver. Mice placed on high fat diets containing control vitamin A levels had a 3-fold higher liver vitamin A concentration compared to those of mice placed on low fat diets. This level was nearly identical to that of mice which had been fed the same low fat diet but containing 25-times more vitamin A than the high fat diet group. Feeding high levels of fat also resulted in a doubling of vitamin A uptake and storage, while limiting potentially excessive fat accumulation.

Conclusions: Administration of high fat diets markedly increases vitamin A stores in the body. By increasing the amount of fat in the diet, it was possible for these animal models to accumulate more vitamin A in the body (in liver and adipose tissue). Since dietary vitamin A is packaged into chylomicrons along with dietary fat upon absorption, fats play an important role in facilitating retinal uptake. Our data reinforces the fact that fats most accompany vitamin A and carotenoid intake since the amount of fat available in the diet will very markedly influence the amount of vitamin A and carotenoids being accumulated into vitamin A stores in the body. This underscores the importance of preparing vitamin A and carotenoid rich foods in oils prior to consumption.
HOLOTRANSCOBALAMIN AS AN INDICATOR OF VITAMIN B12 STATUS: INFLUENCE OF TRANSCOBALAMIN GENOTYPE AND RESPONSE TO SUPPLEMENTATION IN ADULT MEXICAN WOMEN WITH A HIGH PREVALENCE OF B12 DEFICIENCY


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Background: Low and marginal serum B12 concentrations indicating deficiency have been reported in Latin America including Mexico. B12 concentration is often used in population studies as an indicator of B12 status, but its sensitivity in predicting true deficiency has been questioned. B12 on transcobalamin or holoTC has been suggested as a better marker of biologically active B12.

Aims: The purpose of this study was four-fold: 1) assess the prevalence of B12 deficiency in Mexican women, 2) assess the functional and biochemical consequences of B12 deficiency, 3) evaluate the response of holoTC to supplementation, and 4) determine the influence of transcobalamin genotype on B12 status and response to treatment.

Methods: Non-pregnant, non-lactating women (n=132) and Hb >120 g/L were recruited in rural Mexico. Subjects were stratified on baseline sB12 and randomized to B12 supplements (1000 µg i.m. once followed by 500 µg/d oral supplements) or a placebo. Measures at baseline and 3 mo included CBC, sB12, holoTC, MMA, bone alkaline phosphatase (BAP), CRP, plasma homocysteine (tHcy), and whole blood DNA methylation. All subjects were genotyped for the transcobalamin 776C>G polymorphism.

Results: At baseline 23% had low holoTC (<35 pmol/L), 11% low (<148 pmol/L) and 21% marginal (<227 pmol/L); 8% had elevated MMA (>271 nmol/L) and 12% elevated tHcy (>12 µmol/L). 9% of the subjects were homozygous for (RR), 40% homozygous (PP), and 51% heterozygous (PR). TC genotype did not affect holoTC, B12, MMA, BAP, tHcy, or CRP. HoloTC correlated directly with B12 and inversely with MMA and tHcy. Serum holoTC and B12 were compared in detecting B12 deficiency (MMA >271 nmol/L, tHcy >12 µmol/L, and creatinine <97µmol/L) by constructing (ROC) curves. HoloTC and B12 were similarly predictive of increased MMA; neither was predictive of elevated tHcy. Supplementation increased holoTC and B12, and decreased MMA and plasma tHcy.

Conclusion: The use of holoTC was not more predictive of B12 deficiency was than B12 in this study. B12 supplements improved indicators of B12 status (sB12, holoTC, MMA, tHcy) but not the functional indicators. There was no effect of TC genotype on B12 status at baseline or in response to B12 supplementation. The prevalence of the RR polymorphism is lower in this population than in Caucasians and, hence its putative deleterious effects on B12 status indicators may be limited.
**F52**

**MICRONUTRIENTS PROFILE, MALARIA SEVERITY AND POOR OUTCOME IN CHILDREN IN DOUALA, CAMEROON**

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**Background:** The impact of malaria infection and disease on micronutrients status (MS) and vice versa is still controversial. Some studies suggest that Micronutrients Deficiencies (MD) increases the susceptibility to malaria, while others highlight a protective effect at a certain extend. However, the point at which MD ceases to be protective and becomes an adverse prognosticator is not clear. Furthermore, the contribution of MD in the respective symptoms of the different severe malaria (SM) cases (Cerebral malaria (CM) and malaria anaemia (MA)), poor prognosis and fatal outcome have been hardly addressed in the literature.

**Aims:** Prospectively compare some MS of children with different SM symptoms, as well as those with uncomplicated malaria (SCM), as to see by which the way MD as a factor of malaria morbidity, poor prognosis, and poor outcome in fatal cases (FC).

**Methods:** Throughout the year 2007, 225 patients 0 to 15 years old and 45 controls were recruited at 4 hospital institutions in Douala. The study protocol was reviewed and approved by the BCRC. Clinical data and blood samples were collected. Children were allocated to the different groups following the WHO 2000 criteria for severe malaria. Three micronutrients of interest were investigated: Retinol by HPLC, calcium and magnesium by spectrophotometry. Statistical analyses were performed using GraphPad Prism, and a P<0.05 was considered significant.

**Results:** Retinal levels were low in all the groups in regards the reference value of 0.7 mg/dL, but more remarkable in the SM groups. Calcium levels were low in UCM and CM groups (6.8±1.8 mg/dL and 6.4±1.2 mg/dL respectively) in comparison with control and MA groups (7.1±1.6 mg/dL and 7.3±1.5 mg/dL respectively). The level remains low in CM group at discharge, whereas it decreases in MA group. The magnesium levels follow the same trend. Children who died of CM had a particularly low level of retinal. On admission, their calcium level (7.0±2.3; 3.34 mg/dL) was not different from the value obtained in the control group and the magnesium level remained within the normal range (15.6±6.54 mg/dL).

**Conclusions:** Retinol deficiency was more noteworthy in SM groups. Calcium and magnesium levels were found affected by malaria, but this impact seems to be shadowed in MA. Even though MD may increase the risk of malaria disease, it would not be a primary factor associated with poor outcome in FC.

**F53**

**THE ROLE OF THE ACUTE PHASE RESPONSE IN INTERPRETING THE RELATIONSHIP BETWEEN IRON STATUS INDICATORS AMONG ZANZIBARI 6-23 MONTH OLD CHILDREN PRONE TO CHRONIC MALARIA AND HELMINTH INFECTIONS**

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**Background:** The extent to which the acute phase response (APR) influences iron status indicators in chronic infections is not well documented.

**Aims:** We investigated the effectiveness of reported recent fever and 2 acute phase proteins (APPs), C-reactive protein (CRP) and alpha-1-acid glycoprotein (AGP) in revealing this influence.

**Methods:** In a sample of 690 children matched on age and helminth infection status at baseline (two infected for one uninfected child), we measured APPs, hemoglobin concentration (Hb), zinc protoporphyrin (ZPP), serum ferritin (SF), transferring receptor (TR), and erythropoietin (EPO) and determined whether the children had recent fever and malaria infection. We then determined the influence of the APR on iron status indicators using regression analysis with Hb as the outcome variable.

**Results:** SF was inversely related to Hb in the APR-alone model. Adjusting for the APR using reported recent fever alone was not sufficient to reverse the inverse Hb-SF relationship. However, using CRP and/or AGP reversed the inverse relationship to a positive iron deficiency relationship. The best fit model had reported recent fever, AGP and CRP (R²=0.240). The predicted Hb-ZPP, Hb-TR and Hb-EPO regression models had the expected inverse associations and the APR only slightly shifted the magnitude of these relationships. Notably, there was a 6.8 g/L Hb shift in the y intercept in the case of ZPP. The best fit Hb-ZPP model had reported recent fever, AGP and CRP (R²=0.245) while the best fit Hb-TR and Hb-EPO models had reported recent fever and AGP (R²=0.304 and 0.208 respectively).

**Conclusions:** Reported recent fever alone cannot be used to adjust for the APR. Either AGP or CRP is useful if only one APP can be measured. However, AGP better predicted the APR in this population compared to CRP.

**F54**

**EFFECT OF SELENIUM SUPPLEMENTS ON MORBIDITY AND ANEMIA AMONG HIV-INFECTED TANZANIAN WOMEN**

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**Background:** Selenium deficiency may increase risks of anemia and opportunistic infections among persons living with human immunodeficiency virus (HIV) infection.

**Objectives:** To investigate the effect of maternal selenium supplements among 570 HIV-infected women on hemoglobin concentrations and risk of morbidity.

**Design:** Randomized, double-blind, placebo-controlled trial. Eligible women between 12-27 weeks of gestation were given daily selenium (200 µg as selenomethionine) or placebo as supplements until 6 months after delivery. All women received prenatal iron, folic acid, and multivitamin supplements irrespective of experimental assignment.

**Results:** At baseline, the mean maternal hemoglobin concentration was 9.79 ± 1.28 g/dL in the selenium and 9.83 ± 1.46 g/dL in the placebo group. Selenium did not lead to changes in maternal hemoglobin concentrations over follow up (mean difference 0.05 g/dL, 95% CI= -0.07, 0.16, P=0.73) and did not have an effect on time to hemoglobin <8.5 g/dL (Hazard Ratio=0.62, 95% CI=0.22, 1.74, P=0.36). The regimen decreased maternal diastolic blood pressure (Relative Risk=0.59, 95% CI -0.43, 0.82; P=0.002) but had no effect on other morbidity endpoints.

**Conclusions:** Among HIV-infected women living in coastal sub-Saharan Africa, selenium supplements may not improve hemoglobin concentrations, but may reduce diastolic blood pressure.

**F55**

**SERUM AND COLOSTRUMS RETINOL AMONG HIV/AIDS POSITIVE PREGNANT AND BREASTFEEDING MOTHERS AT THIKA DISTRICT HOSPITAL, KENYA**

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**Background:** Vitamin A deficiency (VAD) is associated with decreased immune status and increased morbidity and mortality, particularly among children. Amid the situation of striving to address the HIV/AIDS pandemic, VAD also increased MTCT of HIV.

**Aims:** The main objective of this study was to determine the levels of serum and colostrums retinol in pregnant and breastfeeding mothers. The study was expected to establish the correlation between retinol levels and HIV/AIDS status among these mothers.

**Methods:** Testing maternal blood, cord blood and colostrums samples were obtained from 80 HIV AIDS positive and 80 HIV AIDS negative mothers at Thika District Hospital, Kenya in a cross sectional study design. The samples were analysed for retinol content using HPLC. Demographic data of the mothers was obtained using a questionnaire. Food intake was determined using 24 hour recall schedule and a food frequency schedule.

**Results:** Both groups of mothers, HIV/AIDS positive and HIV/AIDS negative had similar diets and food intake, based on cereal and legume grain staple food. For HIV positive mothers, the serum retinol levels ranged from 1 µg/dl to 26 µg/dl, with a mean of 13 µg/dl. Among HIV negative mothers, the retinol levels ranged from 11 µg/dl to 30 µg/dl, with a mean of 21 µg/dl. Further, 37% of the HIV positive mothers had retinol levels below 10 µg/dl, the cut off for Vitamin A deficiency, while none of the HIV negative mothers had retinol levels below this limit. Colostrums retinol levels among HIV positive mothers ranged from 5 to 265 µg/dl, with a mean of 16 µg/dl. Among the mothers with a negative status, these levels ranged from 15 to 42 µg/dl, with a mean of 25 µg/dl.

**Conclusions:** HIV/AIDS negative mothers had significantly higher serum and colostrums retinal levels than those who were negative. The low retinal levels imply that these mothers were more vulnerable to HIV, and there was a high risk of MTCT of HIV among them. There is need to investigate further the case for the comparatively low retinol levels among the HIV positive mothers.
ANEMIA, MALARIA AND IRON DEFICIENCY IN CHILDREN UNDER FIVE AND WOMEN OF REPRODUCTIVE AGE IN CÔTE D'IVOIRE, WEST AFRICA: NATIONAL PREVALENCE DATA

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Background: The critical impact evaluation of country-wide food fortification strategies is of paramount importance to weigh their costs with public health benefits. Among others, changes in bio-indicators for the target deficiencies need to be assessed, yet only few nationally representative surveys on iron deficiency are available. The results of a baseline survey in Côte d'Ivoire on nutrition status pertaining to iron are reported here as part of the impact assessment of the national food fortification program.

Objective: To assess anaemia and stunting status of children aged 6–59 months and women of reproductive age (15-45 years old) in 9 regions of Côte d'Ivoire, stratified in rural and urban environments.

Design: The survey was conducted in 2007 in 60 randomly selected districts, 30 each for each environment, attributed according to the latest population census (1998) to 9 regions of Côte d'Ivoire. Blood samples were analyzed for hemoglobin, C-reactive protein, zinc protoporphyrin, serum ferritin concentration, and the parasitaemia of Plasmodium spp. Questionnaires were addressed to both individuals and households and socioeconomic status was measured on a household basis using an asset-index.

Results: 74% of all children under five (510/686) had an Hb<110g/L, showing a significantly higher prevalence in the rural environment. For women of reproductive age, a prevalence of Hb<120g/L of 51% (461 of 906) was found. Comparison with earlier data shows that prevalence of anaemia was at best stable in children under five, but may have improved in women of reproductive age. Although parasitemia was low, correlation with higher prevalence of anaemia was clear in both strata. Socioeconomic status was clearly related to Hb values. 85% of children under five were anaemic in the poorest quintile of households compared to 67% in least poor households, following a linear trend. Iron deficiency occurred in 53% of the children below the age of five years, with significantly more children affected in the urban area (60% vs. 39%). Among women of reproductive age, iron deficiency was found in 17% in both strata.

Conclusions: Anaemia remains a serious public health problem in Côte d'Ivoire and is clearly linked to poverty and living in the rural environment. Yet, less poor and urban dwellers also suffer considerably from anaemia. Whilst iron deficiency and malaria parasitemia can explain the high prevalence of anaemia among children in this part, this does not hold for women of reproductive age.

ZINC MODIFIES ASSOCIATION BETWEEN NASOPHARYNGEAL S. PNEUMOIOIAE CARRIAGE AND RISK OF ACUTE LOWER RESPIRATORY INFECTION AMONG YOUNG CHILDREN IN RURAL NEPAL

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Background: Nasopharyngeal (NP) carriage is necessary for S. pneumoniae (Spn) transmission and invasive infection. This study evaluated the effect of zinc prophylaxis on the association between NP colonization with Spn and acute lower respiratory infection (ALRI) in children aged 1-35 mo living in a rural district in southern Nepal. Carriage prevalence of Spn in children 1-36 mo old. Children were randomized to receive either 10 mg tablets of zinc or placebo daily until discharge. Approximately 75% of cases and controls were Spn carriers. There was a significant interaction between zinc and Spn carriage (P=0.001). Spn carriage increased the risk of ALRI in the placebo group (adjusted matched odds ratio [AMOR] =2.57; P=0.025) but not in the zinc group (AMOR=0.95; P=0.890). Among the subset of asymptomatic cases and their controls, the odds of ALRI for Spn carriers in the placebo group was 30 times greater (AMOR=78.09; P=0.000) than in the zinc group (AMOR=2.77; P=0.286). The findings suggest that zinc prophylaxis may protect children against ALRI associated with carriage of Spn and that the effect may differ by infectious etiology.
Factors Associated with Hemoglobin Concentrations in Tanzanian Children: A Cross-Sectional Study

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Background: Iron deficiency and malaria are known determinants of anemia in African children. Little attention has been paid to other possible factors.

Objective: To assess the associations between risk factors for anemia and hemoglobin concentrations in Tanzanian preschool children.

Methods: We conducted a community-based survey among rural children (n=304). Definitions: deficiencies of iron, vitamin A and B12: plasma concentrations of ferritin <12 µg/L, retinol <0.70 mmol/L, and cobalamin <150 pmol/L; inflammation: plasma C-reactive protein concentration ≥8 mg/L.

Results: We estimated the following prevalence values: deficiencies of iron, vitamin A and B12: 13%, 13% and 4%; malaria: 46%; Helicobacter pylori: 31%; inflammation: 33%. In children without malaria, 38% and 4% of children were heterozygous and homozygous for α(+)-thalassemia, respectively. The corresponding estimates for children with malaria were 20% and 5%. We measured the following associations with hemoglobin concentration:

Nutritional factors

<table>
<thead>
<tr>
<th>Association with hemoglobin concentration, g/L</th>
<th>Crude</th>
<th>Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron deficiency</td>
<td>-7.8</td>
<td>(-13.6 to -2.0)</td>
</tr>
<tr>
<td>Vitamin A deficiency</td>
<td>-9.9</td>
<td>(-15.7 to -4.0)</td>
</tr>
<tr>
<td>Vitamin B12 deficiency</td>
<td>-15.8</td>
<td>(-25.9 to -5.8)</td>
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</tbody>
</table>

Infection-related factors

<table>
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<tr>
<th>Association with hemoglobin concentration, g/L</th>
<th>Crude</th>
<th>Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>-8.9</td>
<td>(-12.8 to -5.0)</td>
</tr>
<tr>
<td>Helicobacter pylori</td>
<td>-3.0</td>
<td>(-5.3 to 3.3)</td>
</tr>
<tr>
<td>Inflammation</td>
<td>-13.2</td>
<td>(-17.4 to -9.0)</td>
</tr>
<tr>
<td>α(+)-thalassemia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterozygous</td>
<td>0.7</td>
<td>(-4.6 to 6.0)</td>
</tr>
<tr>
<td>Homozygous</td>
<td>-17.8</td>
<td>(-30.8 to -4.7)</td>
</tr>
</tbody>
</table>

With malaria

<table>
<thead>
<tr>
<th>Association with hemoglobin concentration, g/L</th>
<th>Crude</th>
<th>Adjusted</th>
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</thead>
<tbody>
<tr>
<td>Heterozygous</td>
<td>0.3</td>
<td>(-6.5 to 7.1)</td>
</tr>
<tr>
<td>Homozygous</td>
<td>-5.2</td>
<td>(-20.1 to 9.7)</td>
</tr>
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</table>

Conclusions: Vitamin B12 deficiency, α(+)-thalassemia and possibly vitamin A deficiency are important risk factors for anemia. Homozygous α(-)-thalassemia seems to protect against the malaria-associated reduction in hemoglobin concentration.

Effect of Iron Folic Acid, and Zinc, Alone and Together on Anemia, Iron/Zinc Status and Growth: A Randomized Controlled Trial in an Area with High Malaria Transmission

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Background: Iron deficiency is prevalent in children and infants worldwide. Zinc deficiency may be prevalent, but data are lacking. Both iron and zinc supplementation negatively affect growth and psychomotor development. Combined iron and zinc supplementation might be beneficial, but the potential interactions need to be verified.

Objective: To evaluate the effect of Iron Folic acid, and Zinc alone and together on growth, anemia, iron and zinc status among children aged 1-36 months in an area with high malaria transmission.

Methods: In a sub-study of large randomized placebo controlled trial in Pemba, children were randomized to receive iron folic acid, iron folic acid and zinc, zinc alone or placebo. Children of the sub-study were selected randomly from four districts. Hematological and anthropometric assessments were conducted at baseline, mid-study and end-study. Weekly follow up for supplementation and deaths/hospitalizations was done.

Results: Overall, no effect of iron/folic acid, and zinc, alone and together on growth, anemia, iron and zinc status was observed. However, iron supplementation had shown to improve iron status (Hb [g/dL], diff 0.15, 95% CI: 0.02, 0.28; RDW (%), Diff 0.71, 95% CI: -1.24, -0.18) and growth parameters (WAZ, diff 0.14, 95% CI: 0.02, 0.26) at 6 months. After 1 year of supplementation, we did not find significant differences in any of the growth indices in four intervention groups and only five levels significantly improved with iron supplementation (Hgb [g/dL], diff 14.31, 95% CI: 0.23, 28.40).

Conclusions: Our findings indicate that supplementation with either iron folic acid alone, zinc alone or together did not show beneficial effect on plasma zinc levels and growth; although some beneficial effects of iron on iron status indicators were observed among children of Malaria Endemic Population of Pemba.
EVIDENCE-BASED PROGRAMS

MICRONUTRIENTS, HEALTH AND DEVELOPMENT:

IMPROVING NUTRITIONAL STATUS OF VULNERABLE GROUPS THROUGH A LINKED AGRICULTURAL NUTRITION INTERVENTIONS IN NIGERIA: THE GINA STRATEGY

Friday, 15 May, 2009
Poverty Alleviation and Food Production Programs

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The goal of the GINA (Gender-Informed Nutrition Agriculture) project is to improve the nutritional outcomes, using agricultural-based approaches that explicitly link the work of agriculturalists with that of nutritionists. Overall progress towards this goal was tracked by monitoring changes in “weight for age” of the target population, particularly children under five years of age. The project was designed to deliver these interventions directly to vulnerable, food insecure populations through field-based activities that build the capacity of community members to better address and manage their nutritional needs. The conceptual framework that guides GINA incorporates actions and structures at two broad levels: at the household level and at the community level. Together, these levels provide an understanding of how nutritional outcomes are determined by household resources, how these resources are utilized, and how broader institutions, which typically operate with no or very little participation by the households concerned, impact food security at the individual level. The PHNFA (Participatory Action Planning for Nutrition and Agriculture) model was used to ensure community participation throughout the process of problem identification, implementation, monitoring and evaluation. GINA was implemented on a field trial to test the performance of core priority nutrition and agriculture activities such as the GAMP, ENA and PH Hearth sessions, formation of production groups and provision of new varieties of seeds for both dry and rainy season farming in selected communities in Nigeria. Non-core nutrition but related interventions were also delivered. Key achievements were: Construction of one water borehole facility in each of the project communities, Construction of one food processing facility (cassava and palm oil). Micro-credit for income generation for women issued. CBGMP, ENA and PH Hearth sessions. Enhanced capacity of mothers to ensure the survival of their children. Improved varieties of cassava, planting, mame, cowpeas, pumpkin seeds for home gardening and parent stock goats (Buck & Doe) distributed. Concluded Community Based Information System (CBIS) for nutrition and agriculture intervention assessment. Advocacy visits to facilitate the strengthening of the State Committee on Food and Nutrition (SCFN) and the formation of the LGCAF as a basis for sustainability and the institutionalization of the GINA project at the Local Government Area level. The result showed an average percentage reduction in malnutrition in all project community to be 6%.

HELEN KELLER INTERNATIONAL’S HOMESTEAD FOOD PRODUCTION PROGRAM IN CAMBODIA IMPROVES PRODUCTION, CONSUMPTION AND INTAKE OF MICRONUTRIENT-RICH FOODS AMONG MOTHERS AND CHILDREN BUT THE EFFECTS ON HEALTH AND NUTRITION ARE LIMITED

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Background: Homestead food production programs (HFFP) can improve maternal and child health and nutrition (MCN) through multiple pathways such as increasing household food availability, income and women’s empowerment.

Aim: To evaluate the impact of Helen Keller International’s (HKI) HFFP in Cambodia on production and consumption of and intake of micronutrient-rich (MN)-rich foods, and MCHN.

Methods: Two cross-sectional surveys in October 2005 (baseline) and May 2007 (endline) were used to assess differences between intervention (n=100) and control (n=200) households using t-tests and chi-square tests. Using endline data and multivariate analyses, we tested for differences in MN consumption and intake between intervention (n=300) and control (n=200) households over the five years of age. The project was designed to deliver these interventions directly to vulnerable, food insecure populations through field-based activities that build the capacity of community members to better address and manage their nutritional needs. The conceptual framework that guides GINA incorporates actions and structures at two broad levels: at the household level and at the community level. Together, these levels provide an understanding of how nutritional outcomes are determined by household resources, how these resources are utilized, and how broader institutions, which typically operate with no or very little participation by the households concerned, impact food security at the individual level. The PHNFA (Participatory Action Planning for Nutrition and Agriculture) model was used to ensure community participation throughout the process of problem identification, implementation, monitoring and evaluation. GINA was implemented on a field trial to test the performance of core priority nutrition and agriculture activities such as the GAMP, ENA and PH Hearth sessions, formation of production groups and provision of new varieties of seeds for both dry and rainy season farming in selected communities in Nigeria. Non-core nutrition but related interventions were also delivered. Key achievements were: Construction of one water borehole facility in each of the project communities, Construction of one food processing facility (cassava and palm oil). Micro-credit for income generation for women issued. CBGMP, ENA and PH Hearth sessions. Enhanced capacity of mothers to ensure the survival of their children. Improved varieties of cassava, planting, mame, cowpeas, pumpkin seeds for home gardening and parent stock goats (Buck & Doe) distributed. Concluded Community Based Information System (CBIS) for nutrition and agriculture intervention assessment. Advocacy visits to facilitate the strengthening of the State Committee on Food and Nutrition (SCFN) and the formation of the LGCAF as a basis for sustainability and the institutionalization of the GINA project at the Local Government Area level. The result showed an average percentage reduction in malnutrition in all project community to be 6%.

ENGLAND AND PROTEIN INTAKE IN CHILDREN CONSUMING ONE OF THREE NUTRITIONAL SUPPLEMENTS

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1University of California, Berkeley, United States; 2National Institute for Food and Nutrition, Mexico

Background: Oportunidades program financed this study and holds the rights to the data presented.

Aims: To assess E and P intake from home diet and supplements and program attribution. Aside from these weaknesses, the impact pathway analysis indicated that consumption of the FF may result in some displacement of energy from the usual home diet in children consuming the FF but the observed differences were not significant

Methods: A randomized supplementation study was undertaken in south eastern Mexico in which height, weight and cognitive development, physical activity and exploration were measured before and after 4 months of supplementation with multiple micronutrients. A total of 180 randomly assigned children (n=180), were employed to test the hypothesis that postulated that nutrition (treatment with multiple micronutrient supplements relative to no treatment) would have a direct effect on cognitive and motor development and growth and an indirect effect through increased activity and increased exploration.

Results: The data tended to fit the model with micronutrient treatment versus no treatment having a direct effect on growth and cognitive and motor development. The indirect relationship mediated through activity and exploration (X2 = 17.158, p < 0.04; X2/df = 1.98 where X2/df < 3). When we removed the direct path from nutrition to cognitive development, the direct path from nutrition to motor development and the path from activity to growth, the data fitted the model improved (X2 = 17.158, p = 0.07; X2/df = 1.23). Removing other paths reduced the quality of the data fit to the point where the model no longer fitted. When we removed the perfect fit by removing the direct effect of micronutrient treatment on growth and indirect effects of micronutrient treatment on cognitive and motor development, the model with activity and exploration as mediating variables was a better fit to the data compared to the model with direct effects.

Conclusions: It appears that reduced activity and exploration is one mechanism by which poor nutrition is contributing to reduced development in this vulnerable population of Mexican children.

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F66 COGNITIVE PERFORMANCE OF ANAEMIC SCHOOL CHILDREN IN NORTH WESTERN MOROCCO

Y Mohammadi, A Haro, M Milloud, F Bouteaux
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Introduction: Iron deficiency anaemia has deleterious effects on cognitive development. Many studies have revealed the association between iron status and cognitive scores in children a rural schools in North western Morocco.

Methods: All the 296 primary schoolchildren aged from 6 to 16 years old were observed in a rural area setting. Iron status (Hemoglobin rate and serum ferritin were measured according to international standards).

A battery of psychological and cognitive test was performed. Progressive Matrix of Raven to measure the inductive component of intelligence and the bells barrage to determine visual attention and visual strategy.

Results: Ferritin cut off point of 15 µg/dl has showed that 76 children are iron deficient with 36 of them physiologically anaemic as revealed by their haemoglobin under 11.5 g/dl.

The revealed that ferritin status are associated with school performance measured by the average Maths score and the annual score with R values respectively R=0.27 and R=0.70. Raven test was known to be associated with the maths score in previous studies.

Conclusion: Anaemia need to be treated and iron status be regressed in this school. A follow up study was planned with the partnership of health delegations. Further more a cooperation is underway to perform IRMF explorations to conclude on the kinetics of iron in anaemic children subjects to different cognitive tasks.


F67 IMPACT OF ZINC AND/OR IRON-FOLIC ACID SUPPLEMENTATION ON ATTAINED GROWTH OF PRESCHOOL CHILDREN IN RURAL NEPAL: A CLUSTER RANDOMIZED TRIAL

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Background: Iron deficiency anaemia has deleterious effects on cognitive development. Many studies have revealed the association between iron status and cognitive scores in children a rural schools in North western Morocco.

Methods: A community-based, cluster-randomized, double-masked, placebo-controlled, 2x2 factorial trial of daily supplementation among children 1-35 months of age was conducted in southern Nepal. Treatment groups included placebo, iron-folic acid, zinc, and iron-folic acid + zinc with dosages of 12.5 mg of iron + 50 µg folic acid, and 10 mg of zinc. Children under 12 months received ½ dose. All children received twice yearly vitamin A supplementation.

The growth and development substudy was conducted in 1 of the 30 participating Village Development Committees. Data collection and supplementation began in Oct. 2001. In November 2003, the iron-FA containing arms of the study were stopped on recommendation of the DSMB. These clusters were re-randomized to either zinc or placebo. Zinc and placebo supplementation stopped in Jan. 2006. Post-trial growth was assessed during a final follow-up from Jan. through Mar. 2008. Height, weight and MUAC were measured at that time. Z scores were calculated based on the WHO reference population for those under 5 yrs and on 2000 NCHS standards for those over 5 yrs at the time of measurement.

Results: A total of 391 children were enrolled in the iron-folic acid and iron-FA-plus-zinc vs. placebo arms of whom 316 (81%) were measured; 2227 were enrolled in the zinc, placebo arms of whom 1903 (84%) were measured. Mean Z scores in the placebo group were low: -2.65 for WH, -2.00 for WA, and -1.83 for W/H. There were no significant differences in mean WH, WA, or WH between the iron-FA and placebo groups; nor were there differences in the prevalence of underweight, stunting or wasting between these groups. There were also no significant differences in attained growth in the zinc and placebo comparisons, although the prevalence of stunting was approximately 15% lower and severe stunting was approximately 35% lower in the zinc group compared with placebo.

Conclusions: In this population with high prevalence of poor growth in early childhood, neither iron-FA or zinc supplementation made a significant impact on attained growth when compared with placebo.

F68 CAN MICRONUTRIENTS FROM VEGETABLES ADDED IN NATIONAL FEEDING PROGRAMS SUCH AS MID DAY MEAL (MDM) ENHANCE THE COGNITIVE PERFORMANCE OF SCHOOL CHILDREN?

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Background: National feeding programs such as MDM have been constantly modified by the GR-IPEP guidelines; however, no concrete steps have been taken by the local government to improve the MDM recipes.

Aim: To assess the impact of augmentation of 30-40% vegetables in MDM on the cognitive performance of school children studying in the Municipal schools of urban Vadodara.

Methods: Evaluations on the cognitive performance of children were conducted using Gauratit version of Wechsler Intelligence Scale for Children (WISC) which included the Digit Span, Maze test, Clerical task and Visual memory test. Pre and post supplementation period data were elicited after 71 days from the school children (n=11), SIV-VII, Age 7-15y studying in Municipal schools of urban Vadodara.

Results: Impact evaluations reveal that with a revision of the MDM menu by a team of nutritionists and dieticians (within the cost allocation by the government), there was an increase in calories (449Kcal), proteins (15.3g), fat (5.3g), Beta carotene (1152 mcg, vitamin C (16.4mg) and iron (5mg) per 2 servings (400Kcal) per day.

Overall data on the cognitive scores revealed a small increase in the mean WISC scores after vegetable supplementation. A significant increase was observed in the Digit span scores by 0.9 (p<0.001) after receiving supplementation. Further Maze and clerical test showed small but significant increase in the scores by 0.7 and 0.2 WISC scores(p<0.001).

Conclusion: Encouraging the intake of vegetables through National feeding programs like MDM seems the optimal strategy to improve the cognition of school children. Longitudinal studies using Indian scales to assess the impact of vegetables on cognition of children need to be conducted.

F69 IMPACT OF ZINC AND IRON SUPPLEMENTATION ON AGE AT FIRST WALKING AMONG PRESCHOOL CHILDREN IN RURAL NEPAL: A CLUSTER RANDOMIZED TRIAL


In this iron and zinc deficient population, supplementation with zinc and/or iron did not reduce the time to first walking unassisted, compared with placebo.

Conclusion: In this iron and zinc deficient population, supplementation with zinc and/or iron did not reduce the time to first walking unassisted, compared with placebo. Support National Institutes of Health, Bethesda, MD (HD 38753), the Bill and Melinda Gates Foundation, Seattle, Washington (B/MG 3006), and a Cooperative Agreement between USAID and the Office of Health & Nutrition, US Agency for International Development, Washington DC (HRN-A-DO-07-00015-00).
ABSTRACTS

F70  EFFECT OF MULTIPLE-MICRONUTRIENT SUPPLEMENTATION ON COGNITIVE PERFORMANCE IN CHILDREN: A META-REGRESSION ANALYSIS

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Background: Micronutrient malnutrition is a major problem which may impair cognitive development of children worldwide. Single micronutrient interventions have shown that iron and zinc, and possibly others nutrients such as zinc and B-vitamins, may benefit children’s cognitive performance. A review of 13 studies in western children aged 6-16 years (all of which had developmental disorders) concluded that the majority of studies found beneficial effects of vitamins and minerals on non-verbal intelligence (Benton et al, 2001). After this review, new studies investigating the effect of multiple micronutrients on cognitive performance appeared in literature, of which most were conducted in developing countries in malnourished children.

Aim: We therefore aim to re-evaluate and to quantify the effect of multiple-micronutrient interventions on cognitive performance in children, from infancy till late adolescence (0-18 years old).

Methods: Databases of the Institute for Scientific Information Web of Science, Chinese Biomedical Literature, Cochran (CENTRAL), Embase, Australian Medical Index, Latin American Caribbean Health Sciences Literature and Japan Information Centre of Science and Technology File on Science, Technology and Medicine were searched systematically to identify studies. A meta-regression analysis will be performed to quantify the effect of the intervention on mental and motor development scores and to explain heterogeneity between studies by taking age, country, nutritional status, duration and type of micronutrient supplementation as covariates.

Results: We identified 19 studies in the literature that were eligible for inclusion, of which 16 were conducted in children older than 6 years of age. Thirteen out of 19 studies reported a significant improvement on at least one of the cognitive outcomes. Among studies, the multiple micronutrient intervention varied in dose (30-100% RDA), duration (4-60 wk) and vehicle (supplement or fortified food). Iron-zinc and vitamin B12 were usually included in the supplement. Results of the meta-regression analysis will be presented at the conference.

F72  SHOULD INFANT GIRLS RECEIVE MICRONUTRIENT SUPPLEMENTS?

T Gera1, P Winichagoon2, M Dijkhuizen3, K Cong Nguyen1, E Wasantwisut2, F Wieringa4

1National Institute of Nutrition, Hanoi, Viet Nam; 2Institute of Nutrition, Mahidol University, Nakhon Pathom, Thailand; 3Dept. Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, London, United Kingdom; 4Institut de Recherche pour le Développement, IRD, Montpellier, France

Background: Micronutrient deficiencies are associated with impaired growth and cognitive function in school children. School-based food fortification is a logical preventive strategy. However, efficacy may be affected by the high prevalence of parasitic infection in this age group.

Aim: We therefore aim to re-evaluate and to quantify the effect of multiple-micronutrient interventions on cognitive performance in children, from infancy till late adolescence (0-18 years old).

Methods: Databases of the Institute for Scientific Information Web of Science, Chinese Biomedical Literature, Cochran (CENTRAL), Embase, Australian Medical Index, Latin American Caribbean Health Sciences Literature and Japan Information Centre of Science and Technology File on Science, Technology and Medicine were searched systematically to identify studies. A meta-regression analysis will be performed to quantify the effect of the intervention on mental and motor development scores and to explain heterogeneity between studies by taking age, country, nutritional status, duration and type of micronutrient supplementation as covariates.

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Conclusions: The data suggests that there are some sex-differences in the response to micronutrients with consequences for mortality. We propose that the limited benefit or negative effect of micronutrients in young girls is due to a negative interaction with DOT vaccine. Impressive of the underlying explanation(s), the consistent limited or negative effect on mortality of micronutrients among the youngest girls deserves more attention. Micronutrient supplementation policies might have to differ for boys and girls.

F71  SIX MONTHS IRON-ZINC FORTIFIED MILK IMPROVE WORKING MEMORY OF MARGINALLY NOURISHED SCHOOL-AGED CHILDREN IN POOR URBAN AREA OF EAST JAKARTA, INDONESIA

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Background: Underweight and stunting among poor school-aged children are common nutritional problem in Indonesia, along with high prevalence of iron deficiency anemia, and zinc deficiency. Fortification is one of the alternative micronutrient strategies. However, only few researches studied the impact of fortification on growth and cognitive function among school-aged children. This study provides milk as a fortified vehicle considering that milk is generally well accepted among children.

Aims: to assess the effect of six months iron-zinc fortified milk on nutritional status, mental and motor development in marginally nourished school-aged children.

Methods: Randomized double-blind trials were performed in 5 primary schools in urban area of East Jakarta. A total 209 children aged 7-9 years were randomly allocated into two groups to consumed milk twice daily (5 days/week) for 6 months intervention. Iron-zinc fortified group (n=105) received iron-zinc fortified milk with 0.13mg of iron and 0.44mg of zinc. Anthropometric assessment (height, body weight, MUAC), biochemical indicators (hemoglobin, serum ferritin, serum zinc, CRP), cognitive tests (a battery of 4 tests for attention and memory, and a test for predictive intelligence) were measured at baseline, 1 mo, and 6 mo of intervention.

Results: Prevalence of underweight, stunting, and wasting were 57%, 36%, and 20% respectively.

6 Months intervention, there were significant improvement of body-weights (P< 0.05), but no significant different in improvement of nutritional status and biochemical indicators change between groups. The iron-zinc fortified milk treatment improved scores on tests representing working memory (P=0.002) which significantly higher than in low iron-zinc group. Among stunted children, the iron-zinc fortified milk treatment resulted in significant increases in scores on working memory compare with non-stunted children (P=0.043). No effects were found on general intelligence.

Conclusions: Iron and zinc can enhance working memory capacity among marginally nourished children. Stunted children have a greater benefit to improve quality of information processing for their learning ability. Community-based program should consider iron and zinc in addition to other micronutrients in fortified milk intervention, particularly among undernourished school-aged children.

F73  SHORT-TERM MULTI-MICRONUTRIENT FORTIFIED BISCUITS AND DEWORMING IMPROVED MUAC, DIGIT SPAN AND RAVEN’S COLORED PROGRESSIVE MATRICES TESTS OF COGNITION AMONG RURAL VIETNAMESE SCHOOL CHILDREN

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Background: Micronutrient deficiencies are associated with impaired growth and cognitive function in school children. School-based food fortification is a logical preventive strategy. However, efficacy may be affected by the high prevalence of parasitic infection in this age group.

Aim: The randomized, double-blind, placebo-controlled trial was conducted to evaluate the effect of a school-based food fortification intervention with multi-micronutrients with or without de-worming on growth and cognitive function in school children. In total, 510 eligible primary rural school children, aged 6-9 years, were randomly allocated to either intervention (440 mg, placebo at baseline). In addition, non-fortified or fortified biscuits with multiple micronutrients including iron (6mg), zinc (5.6mg), iodine (35µg), vitamin A (300µg) were given five days a week for four months.

Results: Parasite infestation was highly prevalent (>80% of the children infected), as well as the prevalence of anemia (25%), and deficiencies of zinc (>50% of the children had plasma zinc <8.7 µmol/L), iodine (>50%) of the children had urinary iodine concentrations <100 µg/L) and vitamin A (>10% of the children had plasma retinol concentrations <0.70 µmol/L). Multi-micronutrient fortification significantly improved MUAC (+0.014 cm, 95% CI 0.01, 0.14) but did not affect other indicators of anthropometry, such as skin fold thickness, weight or height. Multi-micronutrient fortification significantly improved recalled items in the digit span forward test (+0.33, 95% CI 0.01, 0.65), and Raven’s Colored Progressive Matrices test (+0.81 score; 95%CI: 0.67, 1.05).

Conclusions: The addition of vitamins and minerals in the fortified products through a school-based program offers a feasible means to supply micronutrients for school children at risk of micronutrient deficiencies. Short term improvements included higher MUAC and better cognition tests (attention and intelligence), especially among anemic children. Long-term effects on nutritional status and growth, as well as other domains of cognition should be further investigated.
PHYSICAL PERFORMANCE IN MARGINAL AND SEVERE IRON DEFICIENT CHILDREN IN A BEIJING MIGRANT SCHOOL OF CHINA

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Objectives: The purpose of this study was to explore the impact of severe ID and marginal ID on physical performance and habitual activity in schoolchildren aged 11-14 years old.

Design: 91 schoolchildren selected voluntarily and randomly were divided into three groups according to their hemoglobin and serum ferritin (SF) status. Marginal ID was defined as SF level is less than minimum cutoff of normal level (15 ug/ml) and Hb level is normal suggested by WHO, while severe ID is defined as both SF and Hb levels are less than normal cutoffs. Hemoglobin (Hb), serum ferritin, serum iron (SI) and sTfR were measured. Physical performance was tested as maximum oxygen consumption (VO2max) and maximum work time. Energy expenditure (EE) and daily physical activity were estimated by 24 hours heart rate (HR) recording. Dietary intake was assessed by frequency questionnaires and physical activity level was estimated by frequency questionnaires and physical activity questionnaire, respectively.

Results: Iron deficiency impaired the aerobic capacity and habitual physical activity. Estimated with fat-free mass (FFM) base, marginal ID female group had a significantly lower VO2max (VO2max/FFM) than iron-adequate groups (P=0.02), but not in male group (P=0.28). Aerobic activity and energy expenditure (EE) at leisure time in severe ID group were significantly lower than marginal ID and iron-adequate groups. Net HR at leisure time was correlated with Hb, log SF, body weight and FFM (P<0.05).

Conclusions: The effect of ID on physical performance and habitual physical activity may negatively relate to ID level. Severe iron deficiency significantly impaired both aerobic capacity and habitual physical activity. Marginal ID impaired FFM based VO2max in female (P=0.024) but not in males.
VITAMIN A SUPPLEMENTS ARE WELL TOLERATED WITH THE PENTAVALENT VACCINE
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Background: The Expanded Programme on Immunisation provides an opportunity to deliver vitamin A supplements to young infants alongside routine vaccination in order to improve vitamin A status. However, concerns have been raised about the safety of administering high dose vitamin A supplements to infants less than 6 months of age in developing countries. A randomised controlled trial was carried out to assess the safety of the pentavalent vaccine (diphtheria-polio-tetanus-Haemophilus influenzae b-hepatitis B).
Aim: To compare the safety of the Hepatitis B and Haemophilus influenzae type b components of the pentavalent vaccine in infants who received 15mg retinol equivalent (RE) vitamin A alongside the pentavalent vaccine at 6, 10 and 14 weeks of age and infants who did not receive vitamin A. All mothers received a post-partum supplement of 120mg RE vitamin A as per national policy.
Methods: Infants were visited 24 hours after vaccination to assess side effects of the vaccine. Mothers were also interviewed about adverse events which the child had in the past four weeks since child was vaccinated.
Findings: There were significantly fewer reports of illnesses and fever in infants who had been given vitamin A compared to infants in the control group. The vaccine was found to be tolerable when administered with vitamin A according to the WHO/EPI schedule for infant immunisation at 6, 10 and 14 weeks compared to when vitamin A was not given with vaccines. Few complaints were made by mothers but these were not thought to be related to giving vitamin A with vaccines.
Conclusion: Vitamin A supplements are well tolerated when administered with the pentavalent vaccine.

VITAMIN A SUPPLEMENTATION HAS NO EFFECT ON ANTIBODY AFFINITY TO HEPATITIS B AND HAEMOPHILUS INFLUENZAE TYPE B VACCINES
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Background: Vaccines are usually assessed by analyses of safety and immunogenicity to determine the effectiveness of elicitation of antibody responses against target organisms. However, it is equally important to establish antibody affinity because of its specific role in protection from infection. This can be determined by comparisons of various antibody concentrations in dose response curves.
Aim: To compare the midpoint titres of antibodies produced at 18 weeks of age to hepatitis B and Haemophilus influenzae type b in infants who had received 15mg RE (50,000IU) vitamin A together with their vaccination at 6, 10 and 14 weeks and infants who did not receive vitamin A; using midpoint titres as a proxy for affinity.
Methods: Analyses were carried out using dilutions of serum samples from an earlier trial on the immunogenicity of a pentavalent vaccine in 888 infants. Antibody affinity analyses of the hepatitis B and Haemophilus influenzae type b components of the pentavalent vaccines were investigated in 222 infants; a 25% sub-sample of the original study. Fitted values corresponding to optical densities from the antibody detection assays were used and a ligand binding equation was used to determine midpoint titres in dose response curves.
Results: Vitamin A supplementation had no effect on the Hepatitis B vaccine component which was observed in the earlier trial was probably due to the amount of antibodies since affinity was unaffected in this analysis.
**ABSTRACTS**

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**IMPROVING MICRONUTRIENT SUPPLEMENTATIONS THROUGH THE ESSENTIAL NUTRITION ACTIONS (ENA) FRAMEWORK IN MADAGASCAR**

A. Rosaha Toiranina, F. Valavanita, K. Ramanaka

**Objective:** To improve and sustain young child feeding practices, increase uptake of micronutrient supplements, and improve women’s dietary practices through implementation of the Essential Nutrition Actions framework.

**Methods:** The ENA framework was applied to provide improved nutrition support through advocacy, capacity building, interpersonal communication, community mobilization, and mass media. Focus groups were held to identify the key nutrition actions and how they can be integrated into the existing health systems and community structures.

**Results:** The micronutrient supplementation and infant feeding guidelines were first adopted in 1999 and have since been used by all nutrition groups, often times with limited resources. The improvement in dietary practices during pregnancy increased from 23% to 91%, and postpartum vitamin A supplementation from 17% to 54%, indicating an increase in breastfeeding of infants within 2 hours of birth increased from 12% to 56%, exclusive breastfeeding of infants within 6 months increased from 42% to 70%, and frequency of feeding of children 6-23 months increased from 8% to 99%, with this a 1-pp point increase. The implementation of the project was successful in achieving the targeted outcomes.

**Conclusion:** The ENA framework promotes key nutrition actions to be taken at key contact points in the life cycle. Maximizing contacts through multiple program opportunities within existing health systems and community structures and through mass media can achieve large-scale coverage of nutrition actions known to have a public health impact in reducing under-five malnutrition.
ANTI – ANEMIC EFFECT OF JATROPHA ACONITIFOLIA AND COLOCASIA ESCULENTA ON RATS

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Background: Iron deficiency anemia and vitamin A deficiencies are still public health problems in Nigeria. The food based approach using locally available food crops appears to be the most feasible intervention programme to address the micronutrient issues in Nigeria. Indigenous green leafy vegetables in Nigeria like Jatropha aconitifolia and Colocasia esculenta could make significant contribution in alleviating iron and vitamin A deficiencies.

Aims: To determine the effect of administering leaf extracts from Jatropha aconitifolia and Colocasia esculenta on iron, vitamin A and zinc status of anemic rats. Methods – Twenty (20) female rats were divided into 4 groups of 5 rats each on the basis of hemoglobin level for a 28 day study period. The first 7 days was acclimatization period, followed by 7 days of inducing anemia, and 14 days feeding trial period. The rats in the control group (Group 1) were fed rat food with ferrous sulphate, the second group was fed rat food with Jatropha aconitifolia, the third group rat food with Colocasia esculenta extract and the fourth group was fed rat chow alone. The leaf extracts and ferrous sulphate were administered orally through drinking water to the rat to provide 0.11 mg/day of iron. Blood samples were collected on days 0, 7, 12, 17, and 22 for hematological determinations. Hemoglobin (HB), serum iron (SI), red blood cell count (RBC) serum ferritin (SF), serum zinc (SZ), and serum retinol (SR) were determined using standard methods. Results – On day 11 (2nd recovery test), the HB and SI levels of the rats fed rat chow and J. aconitifolia were comparable (p > 0.05) with those of the rats fed chow with ferrous sulphate (control) while on day 22 both groups had similar SZ levels. On day 22 (last recovery test), the hematological indices of the rats fed C. esculenta extract were lower (p> 0.05) than those of the control but at 32-36 wk of gestation.

Conclusions: The recovery test of the rats from anemia showed that J. aconitifolia leaf extract compares favorably with ferrous sulphate. J. aconitifolia leaf could be incorporated into the local diets to fight anemia in Nigeria.

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EFFECT OF SUPPLEMENTARY FOOD WITH FERMENTED SOYBEAN TEMPE AND VITAMIN C RICH FRUIT ON MATERNAL IRON STATUS AND PREGNANCY OUTCOMES IN INDONESIA: A COMMUNITY-BASED, RANDOMIZED CONTROLLED TRIAL

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Background: Pregnant women are vulnerable to iron deficiency, and increasing the consumption of iron-rich foods and improving bioavailability without significantly increasing the cost of the diet is the most sustainable intervention in the long term.

Objective: We aimed to assess that supplementary food of fermented soybean (tempe) and vitamin C rich fruit during pregnancy would reduce maternal iron deficiency.

Methods: 252 Indonesian pregnant women on 12-20 weeks of gestation were randomly allocated on the village level into supplementary food and control groups. All subjects were dosed at 18-22 wk of gestation. The food was given 6x/wk, and daily leftovers were weighed. The average weekly food providing 600 g tempe, 30 g red meat/chicken liver/dried anchovy, 45 g soy sauce, 350 g gau, 300 g papaya, and 100 g orange. Supplementary food began at a minimum of 12 weeks gestation and continued until delivery. Primary outcome was maternal iron status. Secondary outcomes were pregnancy outcomes, Hemoglobin, plasma ferritin (SF), transferrin receptor (TRI), CRP, ACR, and stool parasites were measured at 12-20 wk and at 32-46 wk of gestation.

Findings: At baseline, mean HB, SF, TRI, ferritin concentrations or body iron stores were within the normal range and did not differ between the groups. At near term, there was a decrease in mean HB, SF, and body iron and a significant increase in mean TRI in both groups. After control for baseline factors, mean changes in iron status were similar in both groups. In the iron deficient subjects (SF < 30 µg/L), there was a greater decrease in the control group than in the supplementary food group in HB [-1.04 g/L (95% CI -1.107 to -0.972); p = 0.042], in SF [-1.85 µg/L (1.55-2.2) vs. 1.42 (1.16-1.75), p = 0.025], and in body iron [3.36 mg/kg body weight (2.8-4.33) vs. 2.57 (2.17-3.43), p = 0.034]. Pregnant women who were iron deficient at baseline benefited more from supplementary food than those with sufficient iron at baseline. No difference was found in the birth weight [37 g (95% CI -74 to 146); p = 0.51], birth length (0.2 cm (0.1 to 0.7); p = 0.3), or gestational age (-0.2 weeks (-0.7 to 0.6); p = 0.54).

Conclusion: Consumption of daily supplementary food containing tempe and vitamin C rich fruits during pregnancy might have positive effects on maternal iron deficiency compared with no intervention, but had no significant effects on maternal anemia and pregnancy outcomes.

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NUTRIENT COMPOSITION AND MICRONUTRIENT POTENTIALS OF THREE LOCALLY AVAILABLE WILD FRUITS IN NIGERIA

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In the global search for means of combating micronutrient deficiencies especially in developing countries of the world, dietary diversification is being promoted. Spondias mombin, Dialium guineense and Morinda citrifolia which grow wild and consumed raw in the South West and Middle belt of Nigeria were analyzed for their nutritional potential in meeting some or all of micronutrients needs of consumers. Proximate composition, 19 minerals, four vitamins, and seven antinutritional factors of the fresh fruit pulps were determined. Results of proximate analyses showed that the moisture content of Dialium guineense was 4.0g and for Spondias mombin 10.5g/100g. The ash content was 2.2g/100g for Dialium guineense and 3.6g/100g for Spondias mombin. The pH of Dialium guineense was 4.21 and 4.27 for Spondias mombin. The total titratable acidity was 0.6% and 0.5% for Dialium guineense and Spondias mombin respectively. The TSS was 7.4% and 8.5% for Dialium guineense and Spondias mombin respectively. The total sugar content was 4.9% and 5.4% for Dialium guineense and Spondias mombin respectively. The total vitamin A was 1300 µg/100g and 740 µg/100g for Dialium guineense and Spondias mombin respectively. The total vitamin C was 90 mg/100g and 61 mg/100g for Dialium guineense and Spondias mombin respectively. The total calcium was 100 mg/100g and 150 mg/100g for Dialium guineense and Spondias mombin respectively. The total iron was 5.2 mg/100g and 6.5 mg/100g for Dialium guineense and Spondias mombin respectively.

Findings: The three wild fruits have good potential in contributing to the dietary diversification strategy in Nigeria to reduce the risk of micronutrient deficiencies. The pulps can serve as good sources of micronutrients.

Keywords: Wild fruits, Nutrient composition, Micronutrients, Antinutritional Factors.
F85 RISK OF IRON DEFICIENCY ACROSS CEREAL-BASED DIETS IN THE INDIAN POPULATION

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The high prevalence of iron deficiency anaemia in India [1] is often blamed on low iron intakes as well as the low bioavailability of iron in diets heavily dependent on cereals. India’s Green Revolution promoted rice and wheat, shifting many people away from traditional cereals like sorghum and millets. The objective of this paper is to compare cereal-based diets in India over the last 40 years in their ability to provide dietary bioavailable iron (DBI). Odd ratios for inadequate DBI (<50% of basal requirements by sex and age) based on cereal-based diet were calculated using logistic regression analysis controlling for income, tertiary, meat consumption and year. Diets were separated into cereal base as rice, wheat, sorghum, finger millet, pearl millet, maize, rice-mixed or mixed cereal diets, if 50% or more of the total consumed came from one cereal base. A mixed rice diet was defined as 50-80% of the total consumed coming from rice. Reference diets for logistic regression were rice-based diets. National Nutrition Monitoring Board data from 1975, 1996, 2000 and 2001 are used for all adult men and women (n=65,000). DBI was calculated based on individual 24-hour recall data for iron intake as well as iron inhibitors and enhancers as estimated in an iron bioavailability analysis [1]. Results indicate that finger millet, sorghum and maize-based diets are more likely to result in iron deficiency than rice-based diets, regardless of income, year or consumption of meat. However, pearl millet and wheat diets are more protective than rice diets against diet-induced iron deficiency. When compared to rice consumers, pearl millet consumers are 87% less likely, wheat consumers 64% less likely, and mixed cereal consumers 22% less likely to consume insufficient DBI. Mixed rice diets were not significantly different in risk of iron deficiency than rice-based diets. The magnitude of the differences in odds ratios were larger than expected even when controlling for income tertiary and meat consumption. The promise of pearl millet diets (DBI: 0.13, p<0.05) in providing iron should be noted and considered by the nutrition community in India in helping to combat or prevent iron deficiency in some populations. Finger millet contains high amounts of tannins and phytates when compared to any other cereal and is very different in nutrient composition from pearl millet. Nutrionally, millets should not be categorized together in nutritional education or evaluation due to their very different nutritional content. 1. I. Noh-5-2 (2006) National Family Health Survey-III (India) 2005-06. International Institute for Population Studies, Mumbai, India. 2. Halfberg, L., Witham, L. (2000) Prediction of dietary iron absorption: an algorithm for calculating absorption and bioavailability of dietary iron. Am J Clin Nutr 71: 1147-1160.
IMPROVING MICRONUTRIENT SUPPLEMENTATIONS THROUGH THE ESSENTIAL NUTRITION ACTIONS (ENA) FRAMEWORK IN SNNPR, ETHIOPIA

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Background: Ethiopia has some of the highest rates of child stunting, maternal malnutrition, and infant mortality in sub-Saharan Africa.

Objective: To improve infant and young child feeding practices, increase uptake of micronutrient supplements, and improve women’s dietary practices through implementation of the Essential Nutrition Actions framework.

Methods: The ENA framework was applied to provide improved nutrition support through advocacy, capacity building, interpersonal communication, and community mobilization. Emphasis is given to the programmatic integration of these nutrition actions so that they do not operate in isolation from one another and from other child survival programs. Changes in practices were assessed through a comparison of data from representative cross-sectional household surveys for children <2 years collected at baseline in 2003 (1789) and at end of program implementation in 2006 (1200). The surveys were conducted in Southern Nations, Nationalities, and Peoples Region (SNNP) in Ethiopia (population 15 million).

Results: In Ethiopia, micronutrient protocols and infant and young child feeding guidelines were first adopted in 2004, and since have been used by all nutrition groups, often times with limited resources. Iron folic acid supplementation during pregnancy increased from 28% to 39%, and postpartum vitamin A supplementation from 19% to 5%, Vitamin A for children 6-23 months from 24% to 61%, initiation of breastfeeding within 1 hour of birth increased from 64% to 72%, exclusive breastfeeding of infants <6 months from 54% to 66%, all with significant p values. The supplementation of Vitamin showed high coverage levels in children 12–23 months old reflecting the government’s mass campaigns occurring within 6 months of the survey. Improvement was achieved in women dietary practices during pregnancy and breastfeeding during illness. Results were inconclusive regarding food diversity for complementary feeding because of lack of comparable baseline. No improvements were reported in increasing food intake during pregnancy.

Conclusions: The ENA framework promotes key nutrition actions to be taken at key contact points in the life cycle. Maximizing contacts through multiple program opportunities within existing health systems, the health extension programs and existing community structures can achieve large-scale coverage of nutrition actions known to have a public health impact in reducing under-five mortality and morbidity.

Keywords: micronutrients, infant and young child feeding, Essential Nutrition Actions, women nutrition, Ethiopia.
Exhibition Booths Layout on Second Floor
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