Acute childhood malnutrition: Taking science where it is needed

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Outline

• Status of complementary feeding and acute malnutrition in Bangladesh
• The work we have done to improve diets for preventing and treating acute malnutrition
• Our ongoing work
GLOBAL NUTRITION TARGETS FOR 2025

CHILD STUNTING
Cut the number of stunted children by 40%

CHILD WASTING
Reduce and maintain child wasting to less than 5%

CHILD OVERWEIGHT
No increase in childhood overweight

ANEMIA
Cut anemia in women of reproductive age by 50%

EXCLUSIVE BREASTFEEDING
Increase to at least 50%

LOW BIRTH WEIGHT
Cut low birth weight by 30%

HALT THE RISE IN PREVALENCE OF:

ADULT OVERWEIGHT

ADULT DIABETES (high blood sugar)

ADULT OBESITY
<table>
<thead>
<tr>
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<th>AFG</th>
<th>BAN</th>
<th>BHU</th>
<th>IND</th>
<th>MAL</th>
<th>NEP</th>
<th>PAK</th>
<th>SL</th>
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<tbody>
<tr>
<td><strong>Stunting</strong></td>
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<td><strong>Wasting</strong></td>
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<td><strong>Overweight</strong></td>
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<td><strong>Anaemia (women)</strong></td>
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<td><strong>Exclusive BF</strong></td>
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**Legend:**
- **Green**: On course
- **Yellow**: On course at risk
- **Orange**: Off course some progress
- **Red**: Off course

**Source:** GNR, 2016

**Countries largely off course to meet the WHA nutrition targets by 2025**
Stunting, wasting, underweight still major childhood problems in Bangladesh

- Stunting: 36%
- Severe wasting: 3%
- Underweight: 33%

Results from BDHS

<table>
<thead>
<tr>
<th>Condition</th>
<th>2004 BDHS</th>
<th>2007 BDHS</th>
<th>2011 BDHS</th>
<th>2014 BDHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stunting (height-for-age)</td>
<td>51</td>
<td>43</td>
<td>41</td>
<td>36</td>
</tr>
<tr>
<td>Wasting (weight-for-height)</td>
<td>15</td>
<td>17</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Underweight (weight-for-age)</td>
<td>43</td>
<td>41</td>
<td>36</td>
<td>33</td>
</tr>
</tbody>
</table>

- Substantial reduction in stunting and underweight over the last one decade
- But little improvement in wasting
MDD: fed at least 4 out of 7 food groups

MAD: given milk or milk products, foods from the recommended food groups, fed at least the recommended minimum no. of times

[Bar chart showing dietary diversity and meal frequency for Bangladesh, with categories for breastfed children, non-breastfed children, and all children 6-23 months.]
MDD: fed at least 4 out of 7 food groups

MAD: given milk or milk products, foods from the recommended food groups, fed at least the recommended minimum no. of times

Even among the highest wealth quintile, only 33% receive appropriate feeding
Development of Ready to Use Complementary Foods from locally available food ingredients

- IRB approval of proposal
- Market survey since Jan 2011
- Establishment of Food Processing Lab
- Technical committee
- Experiments, evaluations
- Shelf life (sensory and laboratory evaluation)
- Identification of local food industries
Development of recipes

Rice + Lentil = Rice-Lentil based RUSF

Milk powder + Oil + Sugar + Chickpea = Chickpea based RUSF
Establishing the Food Processing Lab in icddr,b
Formation of Technical Committee

- GoB, NGO (national, international), Pediatricians, academia, international agencies, scientists
Testing shelf life of the diets

• Panelists at icddr’b, laboratory testing
Figure 2: Flow diagram of RUSF production.
The study results suggest that rice-lentil and chickpea-based RUSF are well accepted by children.
Growth deceleration occurred from 6 to 18 months of age

Deceleration in LAZ was lower (by 0.02–0.04/month) in the Plumpy’doz (p=0.02), rice-lentil (p=< 0.01), and chickpea (p=< 0.01) groups relative to control

Stunting reduced by 5-6%
Complementary foods and doses

Rice and Lentil Product: 28 g per sachet
Chickpea Product: 23 g per sachet
WSB++: 32 g per sachet (to be cooked)
Plumpy’doz: Distributed in pots of 325 g

1 sachet /d day from 7 to 12 mo of age, and 2 sachets/d from 13 to 18 mo
PD: 1 pot every 2 weeks at 7 to 12 mo of age and 1 pot per week from 13 to 18 mo of age

Provided 125 kcal or 250 g kcal at younger and older ages
Nutrition counseling

- One-on-one counseling was provided
- 9 sessions over 12 months, 45 min/session
- 11 age specific messages: kind & amount of food to eat, responsive feeding, feeding sick children, hygiene
### Effects on stunting & wasting and attained length, LAZ at 18 months of age

<table>
<thead>
<tr>
<th></th>
<th>Control n=1265</th>
<th>Plumpydoz n=1344</th>
<th>Rice lentil n=755</th>
<th>Chickpea n=769</th>
<th>WSB++ n=770</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stunting (LAZ&lt;-2), %</strong></td>
<td>44.2</td>
<td>40.3</td>
<td>43.7</td>
<td>39.1</td>
<td>44.3</td>
</tr>
<tr>
<td><strong>Difference (95% CI)(^1), %</strong></td>
<td>-</td>
<td>-5.0 (-8.8, -1.2)**</td>
<td>-2.2 (-6.5, 2.0)</td>
<td>-6.2 (-10.6, -1.8)**</td>
<td>-3.9 (-8.1, 0.4)</td>
</tr>
<tr>
<td><strong>Wasting (WLZ &lt;-2), %</strong></td>
<td>16.4</td>
<td>13.8</td>
<td>15.6</td>
<td>16.1</td>
<td>17.6</td>
</tr>
<tr>
<td><strong>Difference (95% CI)(^1), %</strong></td>
<td>-</td>
<td>-2.5 (-5.2, 0.0)</td>
<td>-0.5 (-3.6, 2.6)</td>
<td>0.0 (-3.5, 3.4)</td>
<td>1.5 (-2.0, 4.9)</td>
</tr>
<tr>
<td><strong>Length, mean (SD) cm</strong></td>
<td>76.3 (3.0)</td>
<td>76.6 (2.9)</td>
<td>76.4 (3.0)</td>
<td>76.6 (3.0)</td>
<td>76.39 (3.0)</td>
</tr>
<tr>
<td><strong>Difference(^1) (95% CI)</strong></td>
<td>0.30 (0.14, 0.47)**</td>
<td>0.27 (0.07, 0.47)*</td>
<td>0.27 (0.05, 0.48)*</td>
<td>0.27 (0.08, 0.46)*</td>
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</tr>
<tr>
<td><strong>LAZ, mean (SD)</strong></td>
<td>-1.91 (1.02)</td>
<td>-1.80 (0.99)</td>
<td>-1.86 (1.01)</td>
<td>-1.80 (1.05)</td>
<td>-1.87 (1.00)</td>
</tr>
<tr>
<td><strong>Difference(^1) (95% CI)</strong></td>
<td>0.10 (0.04, 0.16)**</td>
<td>0.07 (0.00, 0.14)*</td>
<td>0.08 (0.01, 0.16)*</td>
<td>0.10 (0.03, 0.17)*</td>
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</table>

*Using GEE linear regression analysis adjusting for baseline status; \(^*\)p<0.05, \(^**\)p<0.01*
Summary

• Local RUCF provided daily to children from 6-18 months of age significantly reduced linear growth deceleration and the prevalence of stunting at 18 months of age by 4-6% over and above nutrition counseling alone

• Scaling up will depend upon the context
  – Bulk production locally
  – Targeted distribution through the lowest tiers of health system
  – Distribution through social safety nets
  – Social marketing
Severe Acute Malnutrition

- WH<-3 SD
- Edema both feet
- MUAC <11.5 cm

At risk of death from

- Hypoglycemia
- Hypothermia
- Infections
Severe Acute Malnutrition

• WH<-3 SD
• Edema both feet
• MUAC <11.5 cm

At risk of death from

• Hypoglycemia
• Hypothermia
• Infections

Affects 19 million and kills ~1 million each year
Management of SAM

• Stabilization, hospital-based, only ~5-10%
• Community-based nutritional rehabilitation
• Prevention through food security and health care programs
COMMUNITY-BASED MANAGEMENT OF SEVERE ACUTE MALNUTRITION

Acute Malnutrition

Severe acute malnutrition (SAM)

- SAM With Complications
  INPATIENT CARE
  Treatment comprises first 7 steps of the National Guideline for Management of SAM (stabilization) at facility. When completed, the child is transferred to community based care

- SAM Without Complications
  OUTPATIENT CARE
  Children with SAM without complications are given Nutritional Treatment (NT) and routine medicines at an outpatient site or directly in the community

Moderate acute malnutrition (MAM)

- MAM - PLW
  OUTPATIENT CARE
  Children with MAM are given a Nutritional Supplement (NS) and routine medicines at an outpatient site or directly in the community. Malnourished PLW can be included.

Community Outreach Activities
Identification of acutely malnourished children, referral to outpatient site for care, follow up and prevention
Ready-to-Use Therapeutic Food

- Energy dense: 500 kcal/92g
- Same formula as F100 (except it contains iron)
- No microbial growth even when opened
- Safe & easy for home use
- Is given after breast milk
- Safe drinking water should be provided
- Well liked by children
Local diets for treatment of SAM

Development at kitchen scale

Development in industry
Methods

- Double blind randomized clinical trial
- Study sites: 3 sites

Dhaka Hospital icddr,b, Dhaka
Terre des Hommes, SNU Kurigram
Radda MCH FP Center Mirpur Dhaka
Flow chart of study participant enrolment and intervention

1. Anthropometric measurements of admitted or OPD patients
2. Receive the standard WHO management for SAM during acute phase
3. Recover from acute phase
4. Randomize and appetite test by intervention diet, if passed
5. Achieves the discharge criteria and discharge with advice
6. Continue study intervention @ 200 kcal/kg/day in 7 divided meals
To compare the efficacy in terms of rate of weight gain (g/kg per day) of children with SAM treated with the different diets.
Sample size

Considering a standard deviation of the mean of the rate of weight gain to be 5.3, power 80%, $\alpha$ of 0.05, and accommodating for 20% dropout, the sample size was estimated to be a total of 327 participants (109 in each of three arms)
Study activities in Terre des Homes, Kurigram
A 11 month old girl randomized to one of the three RUTFs, on day 1

On day 18 when she was discharged
Summary of therapeutic diet studies

- Daily weight gain & duration of stay to achieve the discharge criteria were comparable among all the intervention groups.

- We conclude that both the local diets, i.e. Sharnali-1 & Sharnali-2 are as good as Plumpy’Nut in treating children suffering from SAM.
Current treatment is not effective

<table>
<thead>
<tr>
<th></th>
<th>Sphere standard</th>
<th>OTP</th>
<th>SFP</th>
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<tbody>
<tr>
<td>Length of stay, days</td>
<td>≤60 d in OTP</td>
<td>70 days</td>
<td>71.5 days</td>
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<tr>
<td></td>
<td>≤90 d in SFP</td>
<td></td>
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<tr>
<td>Mean rate of weight gain</td>
<td>&gt;5 g/kg/d for OTP</td>
<td>2 g/kg/d</td>
<td>1.75 g /kg/d</td>
</tr>
<tr>
<td></td>
<td>&gt;3 g/kg/d for SFP</td>
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Pakistan country case study, UNICEF 2012
**Current treatment is not effective**

<table>
<thead>
<tr>
<th>Diet group</th>
<th>WLZ score enrolment</th>
<th>WLZ score on 15% wt gain</th>
<th>WLZ score follow up</th>
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</thead>
<tbody>
<tr>
<td>n=224</td>
<td></td>
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<tr>
<td>Halwa/khichuri</td>
<td>-3.96 ± 0.79</td>
<td>-2.86 ± 0.92</td>
<td>-2.24 ± 1.03</td>
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<tr>
<td>RUTFs</td>
<td>-3.85 ± 0.64</td>
<td>-2.66 ± 0.68</td>
<td>-2.18 ± 0.97</td>
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</tbody>
</table>
**First POC study - Children with MAM**

**Outcome measures:**
- Repair of microbiota immaturity (MAZ score)
- Impact on enteropathogen burden
- Anthropometry
- Serum biomarkers [e.g., metabolites indicative of metabolic flexibility; insulin, leptin, IGF-1, bone formation (P1NP, CTX, IL-6, osteoprotegerin); trp/kyn etc.]
Requirements for such studies

Study population

Appropriate trial design

Health care clinic

DSMB
stands for Data Safety Monitoring Board
Local dissemination

The Daily Star
10 Jan, 2015, Page 8
Col 12, CI 7.67

Super cereal developed by ICDDR,B will help combat severe malnutrition

The International Centre for Diarrhoeal Diseases Research, Bangladesh (ICDDR,B), has formulated a ready-to-use therapeutic food formulation made from local abundant ingredients that help address severe acute malnutrition (SAM) in children under the age of 5 in the country. The product is made from a combination of rice, lentil, egg, sweet potato and vegetables, and can be produced domestically. (Photo: Daily Star)

Daily Star
9 Jan, 2015, Page 4
Col 2-5, CI 10.28

شهر আগষ্ঠ আনোয়ার

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The Daily Star
10 Jan, 2015, Page 8
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Collection of stool within 20 minutes of production and put it into dry shippers

Our experience with the last 70 samples: ~7 minutes
Track record with RUSF and RUTF
The Study Team

Dr Ishita Mostofa
Dr Imtiaz Mahmud
Dr Md. Iqbal Hossain
Dr Md. Munirul Islam
Ms Nuzhat Choudhury
Dr Shafiqul Alam Sarker
Dr Michael Barratt
Dr Tahmeed Ahmed

Dr Muttaquina Hossain
Dr KM Shahunja
Dr Sayeeda Haq
Dr Mustafa Mahfuz
Dr Santhia Ireen
Dr John Clemens
Dr Jeffery Gordon