Environmental Enteropathy

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Outline

Malnutrition & Stunting

The Dirty Chicken Story

Definition

Features

Management
Malnutrition & Stunting

Malnutrition attributed to 1/3 of all deaths in children less than 5 years of age.

Stunting: Height for age <3SD

Globally: 25%, Kenya: 26%

Increased morbidity and mortality in childhood.

Long term: affects cognitive function, work output, stunted women with small children.

Kenya Counties Facts Sheets. 2014 Kenya Demographics and Health Survey (OF28)
<table>
<thead>
<tr>
<th>Maternal and birth outcomes</th>
<th>Newborn babies</th>
<th>Infants and young children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron folate supplementation</td>
<td>Promotion of breastfeeding (individual</td>
<td>Promotion of breastfeeding (individual and group counselling)</td>
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<tr>
<td>Maternal supplements of multiple micronutrients</td>
<td>and group counselling)</td>
<td>Behaviour change communication for improved complementary</td>
</tr>
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<td>Maternal iodine through iodisation of salt</td>
<td></td>
<td>feeding for infants*</td>
</tr>
<tr>
<td>Maternal calcium supplementation</td>
<td></td>
<td>Zinc supplementation</td>
</tr>
<tr>
<td>Interventions to reduce tobacco consumption or indoor</td>
<td></td>
<td>Zinc in management of diarrhoea</td>
</tr>
<tr>
<td>air pollution</td>
<td></td>
<td>Vitamin A fortification or supplementation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Universal salt iodisation</td>
</tr>
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<td></td>
<td></td>
<td>Hand washing or hygiene interventions</td>
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<td></td>
<td>Treatment of Severe Acute Malnutrition</td>
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Nutrition Interventions

Despite several nutrition interventions, rate of stunting has only decreased by 1/3

Any other factors?

Diarrhoea
Hygiene
Sanitation
HIV
Dirty Chicken Study

Dirty Chick
Raised in 'usual' chicken cages filled with feces, dust, and dander

Clean Chick
Raised in cages that were steam-cleaned

Slides courtesy of J Humphrey
Dirty Chicken Study

- 'Clean Chicks' grew better than 'Dirty Chicks'
- 'Dirty Chicks' fed antibiotics grew as well as 'Clean Chicks'
- Antibiotics did not improve growth in 'Clean Chicks'
- Poor growth in 'Dirty Chicks' accompanied by elevated plasma IL-1 (indicator of immune stress)
- Elevated IL-1 not observed in 'Clean Chicks' or 'Dirty Chicks' fed antibiotics
Enteropathy

- Is subclinical inflammation of the GIT contributing to the malnutrition?

- Tropical enteropathy:
  - Adults visiting tropical regions developed malabsorption
  - Biopsies showed villous blunting
  - Treated with long term antibiotics
  - Resolution of symptoms on returning to “home” country
  - Children in low SES noted to have similar features

- Term replaced with Environmental Enteropathy
Environmental Enteropathy

- Also known as Environmental Enteric Dysfunction (EED)
- Incompletely defined syndrome of GIT inflammation
- Flat, inflamed gut characterized by:
  - Villous blunting
  - Some malabsorption
  - Inflammatory cell infiltrates in the gut mucosa
  - Increased permeability
  - Bacterial overgrowth
EE/EED: Features

Diarrhea
Impaired nutrient absorption
Enhanced microbial translocation
Local and systemic T-cell immune activation
Poor vaccine uptake?
Poor sanitation and hygiene
Fecal contamination of domestic environment

Fecal ingestion by infants and children → Enteric infection

Increased intestinal permeability ← Intestinal Inflammation

Bacterial translocation → Innate and Acquired Immune activation

Environmental Enteropathy:
- Chronic villus atrophy,
- Crypt hyperplasia,
- Inflammatory cell infiltrate

Blunted enteric immune response
Malabsorption and malnutrition

Oral vaccine failure
Increased susceptibility to infection

Increased child morbidity and mortality
Reduced cognitive development
Reduced adult economic productivity
EE: Vaccines

- EE may reduce efficacy of oral vaccines
  - ?Over-vigorous local immune response with destruction of live attenuated vaccines

- Rota virus vaccine:
  - Africa 39.3%
  - Asia 48.3%
  - Europe/America 85-98%

- Stunted Bangladesh children significantly lower OPV response by 1 year compared to non-stunted children
Diagnosis

- Confirmation: endoscopy and small intestinal biopsy
- Dual sugar absorption test: Lactulose:Mannitol test
  - Lactulose large sugar, not absorbed
  - Mannitol small sugar, absorbed according to GIT surface area
  - Urinary mannitol: index index of absorptive capacity
  - Urinary lactulose: impaired barrier function
- Endotoxin Core Ab (EndoCab)
  - Secreted by gram negative bacteria
The Gambia study

- Infants 3 months to 14 months
- Malnutrition and stunting despite nutritional intervention
- No diarrhea
- Features of EE (increased L:M ratios, higher EndoCab)
Treatment Trials

- **WASH Trials:**
  - Water, Sanitation and Hygiene
  - Modest improvement in stunting

- **Supplements:**
  - Zinc, Vitamin A: improved L:M ratio, no effect on height
  - LCPUFA: no change

- **Antibiotics:**
  - Rifaximin, Albendazole: no difference

- **Probiotics:** no improvement
Recommendations

- Holistic approach to nutritional rehabilitation
- Minimizing feco-oral contamination
  - Risk of allergic tendency?
- More research!

Crane J. EED; an overview. Food and Nutrition Bulletin 2015
Thank You!