Water Scarcity, Food Insecurity and Sub-optimal Health: Connecting the Dots for Central America

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Central America
Contemporary Guatemalan Nutritional Situation

- Acute Undernutrition (wasting)
- Chronic Undernutrition (stunting)
- Global Undernutrition (underweight)
- Micronutrient Deficiencies
OUTLINE OF THE PRESENTATION

- Acute Water Shortage
  - Case History for Corredor Seco 2009

- Under-Utilization of Potable Water and Water in Cleansing, Sanitation and Hygiene
  - Biology of Retarded Early Growth
ACUTE DROUGHT

ACUTE FOOD SHORTAGE

SEVERE MALNUTRITION
The 2009 Hunger Outbreak in the *Corredor Seco* (Drought Swath)
Drought aggravates food insecurity in Honduras and Guatemala

*Christian Smets*

Guatemala latest country to declare food crisis: nearly half a million families face food shortages

*Jeremy Hance*

Millions Devastated by Deadly Drought In Guatemala

*Nadia McGill*
Aspect of the Drought in 2009
The Drought Scenario

- In Guatemala, 75 per cent of the rural population live under the poverty line.
- In 2009, the worst drought in 30 years affected some 2.5 million people in Guatemala —roughly 20 per cent of the country’s population. . . . . . . . caused by the El Niño cyclical climatic phenomenon.
Food Shortages
Basic staples of Eastern Guatemala
Incident Malnutrition

Its (UN Humanitation Survey, Oct 2009) findings suggested that 11 per cent of the area’s children under five years of age and 23 per cent of women between 10 and 19 years old were severely or moderately undernourished.
Malnourished Household
Lessons Learned

- The droughts in Guatemala cannot be prevented, but the process of desertification in south-east Guatemala can be addressed.
- Reservoir storage for irrigation agriculture could be set in place, but resources for such investment would be hard to mobilize.
- Earlier and more rapid food assistance could be mobilized.
- Earlier and more skilled management of malnutrition cases can be assured.
Potential Consequence Of Episodic Food Deprivation

- Jerusha Nelson Peterman, RD, PhD, Parke E. Wilde, PhD, Sidney Liang, MPA, Odilia I. Bermudez, PhD, MPH, Linda Silka, PhD, and Beatrice Lorge Rogers, PhD

Malnourishing Household
Guatemala has severe, endemic Chronic Malnutrition

- **Chronic Malnutrition**
  - In 2005, 49% stunting in <5 y
  - In 2009, 43% stunting in <5 y
Guatemala has severe, endemic Chronic Malnutrition

- Less than 40% of the variance in the origin of stunting can be attributed to diet and nutrients.
- Growth faltering begins during the first 6 months of life, when exclusive breastfeeding should be the dietary option.
The “Dirty Chicken” Phenomenon
Environmental Sanitation and Chronic Malnutrition

- Solomons et al 1993

- Cannon, 2010
  . . . factors which make children short, and which also make them in some sense physically or mentally backward or even retarded. . . . include repeated infections and infestations, diets that are inadequate sources of energy even for small people, and also are poor or deficient in various micronutrients and other bioactive substances. They also include broader determinants of ill-health such as unsafe water supplies, inadequate primary health care, poor schooling, and all the other manifestations of poverty and misery.
Environmental Sanitation and Chronic Malnutrition, contribution from McGill research
Panama Study Site
Environmental Sanitation and Chronic Malnutrition, contribution from McGill research

Cytokine Model of Height for Age Z Score (HAZ) in Preschool Children (n = 131)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Parameter Estimate (SE)</th>
<th>P</th>
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<tbody>
<tr>
<td>Age, mo</td>
<td>-0.03 (0.01)</td>
<td>&lt;0.0001</td>
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<tr>
<td>Female, 1=yes</td>
<td>0.45 (0.21)</td>
<td>0.03</td>
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<tr>
<td>Diarrheal episodes / mo</td>
<td>-0.07 (0.04)</td>
<td>0.07</td>
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<tr>
<td>Ascaris, ln epg</td>
<td>-0.04 (0.02)</td>
<td>0.09</td>
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<tr>
<td>IL-1β, pg/ml</td>
<td>-0.06 (0.02)</td>
<td>0.0004</td>
</tr>
<tr>
<td>IL-10, pg/ml</td>
<td>0.03 (0.001)</td>
<td>0.0001</td>
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\[
R^2 = 0.2908 \\
F = 8.47 \\
P < 0.0001
\]

Stepwise model included ln(Trichuris epg), # respiratory infections in past month, IL-2, IL-4, IL-5, IL-6, IL-13, IL-17, TNF-α, IFN-γ

Irwin-Kristmanson 2009
Maternal High Dose Infection Decreased FETAL Crown-Rump Length

Odiere et al. 2010
Hypothesis: maternal infection and PD alter chemokines and hormones involved in bone formation, resulting in impaired neonatal skeletal development.
Combined Protein Deficiency and Infection Reduced Leptin in Pup Serum at Day 14 PP

Odiere et al. in press
J Nutrition
Environmental Sanitation and Chronic Malnutrition, contribution from McGill research

Evidence Supporting Role in This Pathway

Leptin

-ve

Infection

Growth Hormone

-ve

Protein Deficiency

-ve

IGF-1

-ve

Neonatal Bone Development

Crown-Rump Length
Environmental Sanitation and Chronic Malnutrition, contribution from McGill research

Evidence Supporting Role in This Pathway

Leptin → Growth Hormone → IGF-1 → IL-1B → Neonatal Bone Development → Crown-Rump Length

+ve

Infection → GC's → Protein Deficiency
Malnutrition and Health: Availability and Use of Clean Water
Malnutrition and Health: Availability and Use of Clean Water
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