Presentation 3-03 UNL – Relations between water quality and child development worldwide: The special case of stunting, Dr. Helen Raikes

Relations between water quality and child development worldwide: The special case of stunting via early alterations in the microbiome

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Water Quality, Nutrition & Early Child Development

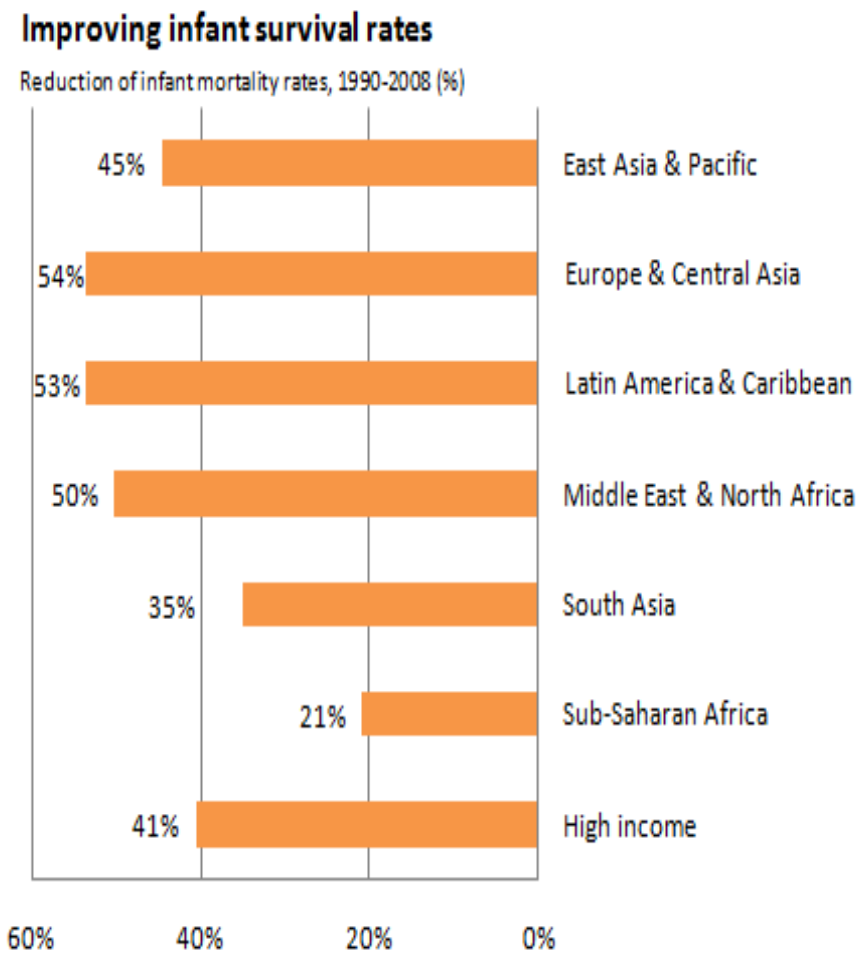
Theme: Relations of Water Quality (through Nutrition) to Early Child Cognitive, Growth in Height (Stunting) and Microbiome Development

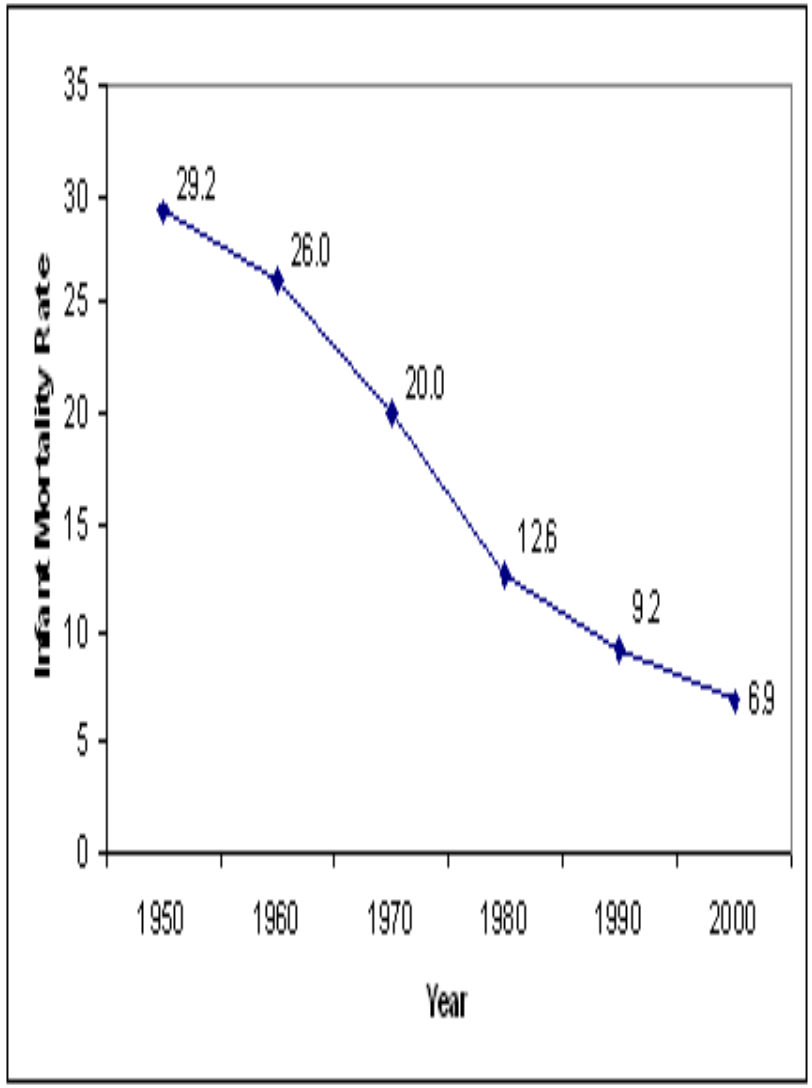
1. **Throughout the world human capacity is compromised due to cognitive deficits and physical stunting in earliest years.**
2. **There are links between this lost capacity and water quality.**
3. **The mechanism is through nutrition and nutritional absorption in human microbiome.**
4. **Opportunities exist for new interdisciplinary research efforts.**

Throughout the World Human Capacity is Compromised by Stunting and Cognitive Deficits in Early Years.

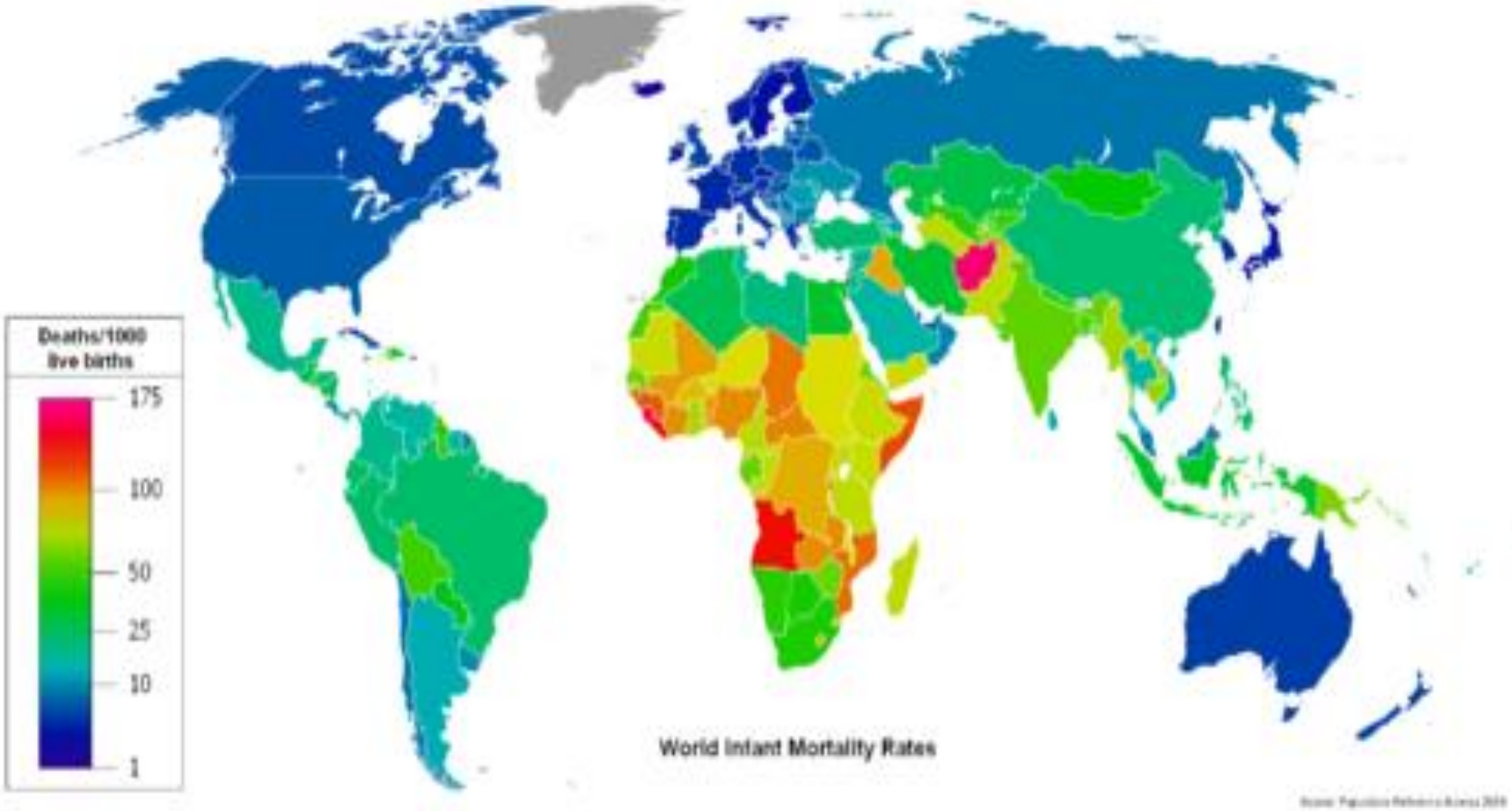
- **More children are surviving—decreasing infant mortality rates.**
- **But not thriving in cognitive and physical growth—tremendous implications for countries.**
- **My academic focus area is early childhood education—but particularly focused on children at risk in the US and world wide, including a collaborative research project in Turkey.**

US and Worldwide: Reduced Infant Mortality





Variation in Infant Mortality Continues- Worldwide



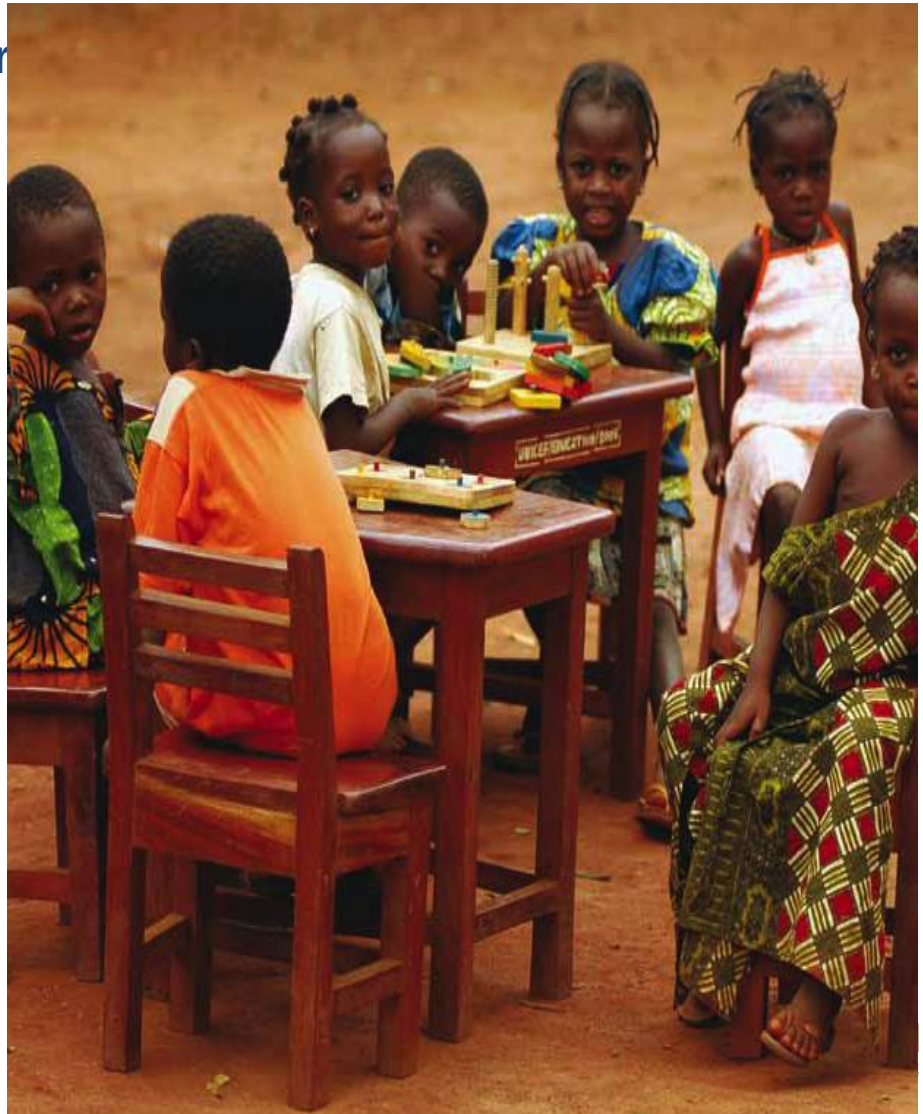
More Children are Surviving: Millions Are Not Thriving

- Around 7.6 million children under age five still die each year, most from preventable diseases (USAID, 2012).

The Lancet:

- Over 200 million under 5 children in developing countries are at risk of not developing their full potential

- ***Risk Factors:*** Poverty, poor health, nutrition and environment (including water quality), lack of stimulation and learning opportunities



Early experiences are built into our bodies.

One developmental period builds on another.

Development is particularly affected by sensitive periods for different kinds of growth.

In the first 3 years, brain architecture, linear growth trajectories are established. Newer studies suggest that gut health is established during this time.

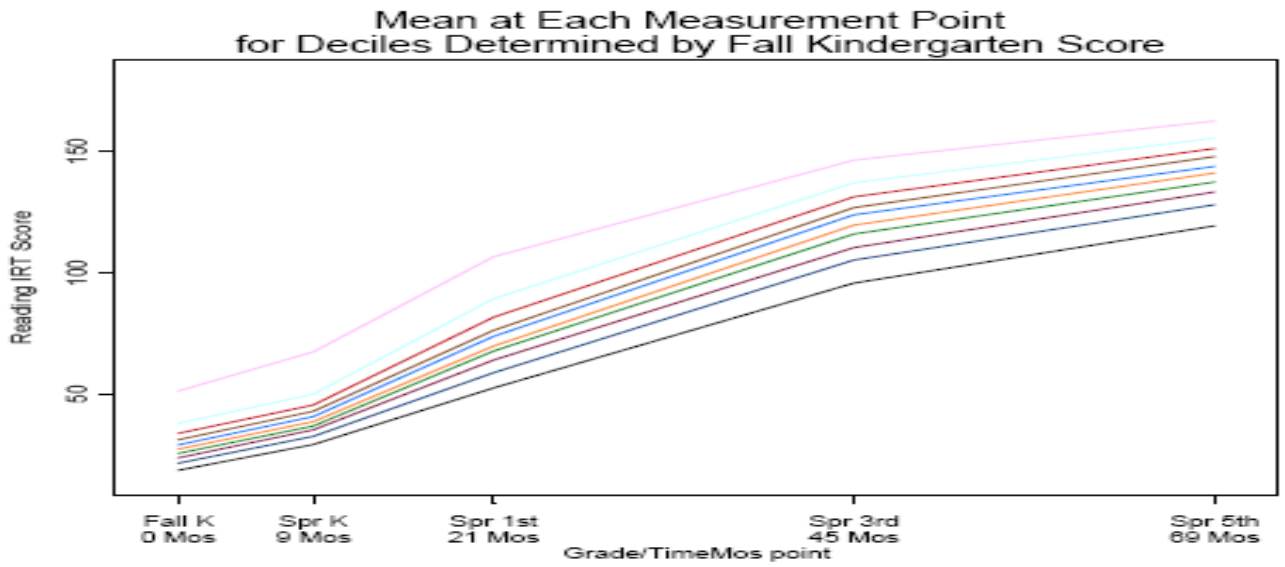
Early years are fragile due to fast growth, sensitive periods and requirements for nutrition and stimulation.

Three areas of compromise: cognitive and height and potentially the microbiome.

Compromised Cognitive Development

Differences in brain development lead to achievement gaps between poor and advantaged children.

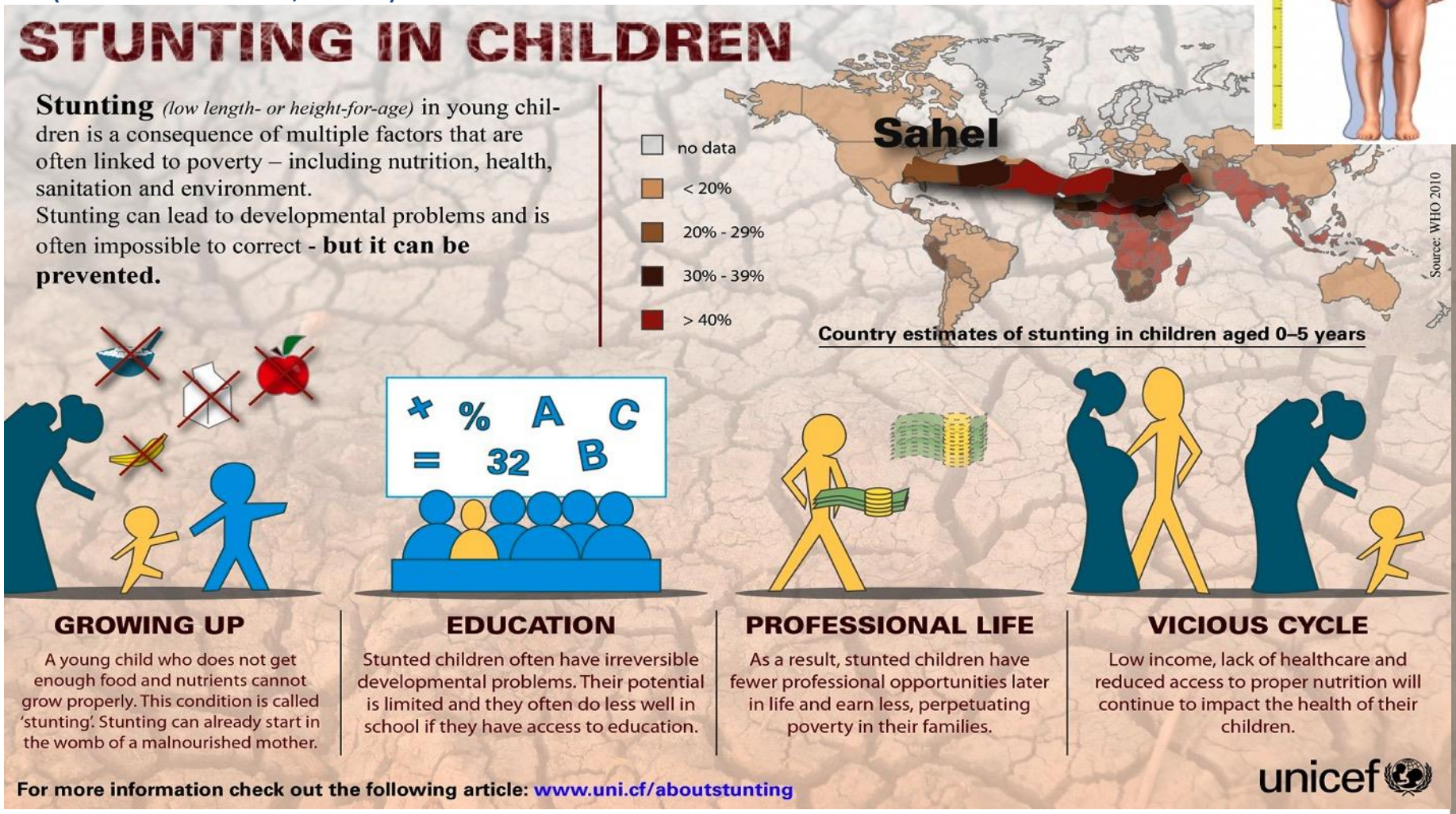
Exhibit 3:

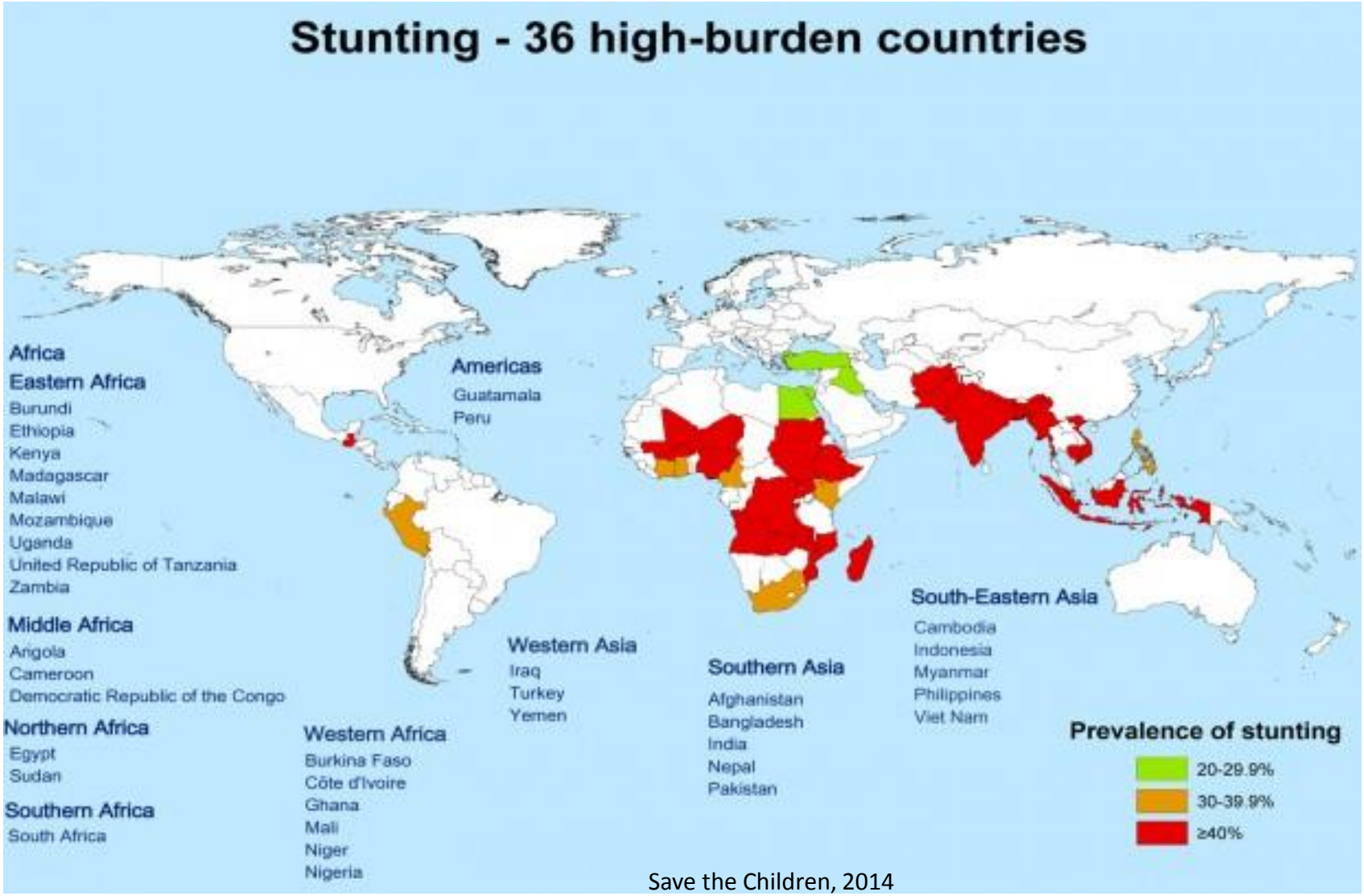


Evidence Children are not Developing to Full Potential: Stunting

Physical Stunting: 27% of world population

Stunting at 24 months associated with .9 year reduction in schooling (Martorell et al., 2010).





Save the Children, 2014

One Component: Water Quality

- **Lack of clean water associated with diarrhea and pneumonia which are two of the main killers of children under 5 in developing countries.**
- -Diarrhea and pneumonia both lead to malnutrition.
- **Repeated incidents of diarrhea may lead to impaired cognitive development and stunting (WHO, 2013; Luby, 2008).**
- -Stunting at 24 months associated with .9 year reduction in schooling (Martorell et al., 2010).
- **Subclinical (not overt diarrhea) levels of bacteria from contaminants associated with less absorption of nutrients in food leading to stunting, wasting and poor brain and cognitive development.**
- **Gut microbiome changes in structure and function may decrease efficacy even with nutrition interventions: Reductions in height of small intestinal villa; increases in lymphocytes: Impaired mucosal barrier integrity: inflammation**



Water Quality/Sanitation: Water-borne Bacteria and Chemicals

4 kinds of studies:

1. **Sanitation: Open latrine density is associated with child stunting. (Spears, 2012; Spears, 2013)**
2. **Family Water Quality: MDG goal to halve the proportion of people without sustainable access to safe drinking water was met in 2012; when water supplies in homes are used for multiple purposes, the ensuing bacteria are harmful to youngest children.**
3. **Supplemental Food: Water quality especially important when children are receiving supplemental food after breastfeeding.**
4. **Other Contaminants: A problem throughout the world to the developing organism. Documented toxins to development: arsenic, lead, mercury, specific pesticides.**

New York Times, Poor Sanitation in India May Afflict Well-Fed Children with Malnutrition, July 13, 2014

- **"…children's bodies divert energy and nutrients away from growth and brain development to prioritize infection-fighting survival. When this happens during the first two years of life, children become stunted. What's particularly disturbing is that the lost height and intelligence are permanent." Jean Humphrey, Johns Hopkins Bloomberg School of Public Health**
- **"Our realization about the connection between stunting and sanitation is just emerging." Sue Coates, UNICEF India**
- **"India's stunting problem represents the largest loss of human potential in any country in history, and it affects 20 times more people alone than H.I.V./Aids does around the world." Ramanan Laxminarayan, Public Health Foundation of India**

The New York Times

Research Opportunities for the future

- **Study populations of vulnerable young children (< age 5) to determine**
  - Population-level cognitive development
  - Population-level height (stunting)
  - Population-level microbiome characteristics
  - Water quality/together with nutritional factors
- **Study relations between microbiome and stunting and cognitive development**
- **Develop and measure effects of interventions**