LNS & RUSF in transdisciplinary nutrition programming: the Haiti experience

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FSN Network Nutrition & Food Technology Task Force
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Presentation outline

1) Introduction: Transdisciplinary Nutrition
   a.) WHO Framework for Stunted Growth & Development

2) LNS & RUSF: Research in Haiti
   a.) Nutributter: complementary food security
   b.) VitaMamba: school feeding

3) Conclusions: Integrated Nutrition Programming
   a.) Water & microbiome
   b.) Anemia & child development

WHO Framework (Stewart et al. *MCN* 2013)

LNS & RUSF RESEARCH IN HAITI

Haiti: context

- History
  - Occupation, dependencies→ weakened healthcare system
  - Major earthquake Jan 2010
  - Cholera & widespread diarrhea
- Rapid urbanization and poverty
  - >50% population live urban areas; 3.9 % per year
  - 80% in poverty (less than $2); 54% in abject poverty (<$1)
  - 10% land with permanent crops; deforestation; dependency on food imports
- Nutrition (DHS 2012)
  - 20.9% stunted, 11.4% underweight, 5.1% wasted
  - 65% of infants 6-59 mo were anemic; and16.9% of children 6-59 mo live in HH with iodized salt
  - 23% 4 food groups/d; 7% eggs; 18% meat or fish
- Infection & WASH
  - 21% acute diarrhea; leading cause of child death.
  - 80% without access to sanitation

Cap Haitien


BAIE DU CAP-HAÏTIEN
La Violette
Belair
La Fossette
Shada 1
EPPLS
Barrier Bouteille
Shada 2
St. Philomene
Conasa
GOYAVE
Cite de Peuple
BASSIN RODO
Fougerolle
Cite Chauvel
Campin
Fort St. Michel
Bas Aviation
Vertieres
Blouil
Petit Anse

Fortified peanut butter paste

A. Boshara photo 2012

- Prevention, not treatment!
  - Intervene early to prevent stunting
  - Micronutrient nutrition in school age children

- Poverty intervention
  - high quality food + education
  - Local peanut farmers & economic development

MFK 2013

M. Kasparian photo, 2012

COMPLEMENTARY FOOD SECURITY: NUTRIBUTTER TRIAL

Partners & Funders

Washington University in St. Louis
George Warren Brown School of Social Work

Meds & Food For Kids
www.mfkhaiti.org

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A partnership to save lives and improve health care in northern Haiti

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Global Nutrition Solutions

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Objectives

To test the efficacy of a small-quantity lipid-based supplement (LNS), Nutributter® (NB), delivered within an integrated package of services (IP) on promoting linear growth, over time

- improve complementary feeding practices in poor urban context
- examine effects of NB on infant and young child feeding (IYCF) practices

Study Design – mixed methods

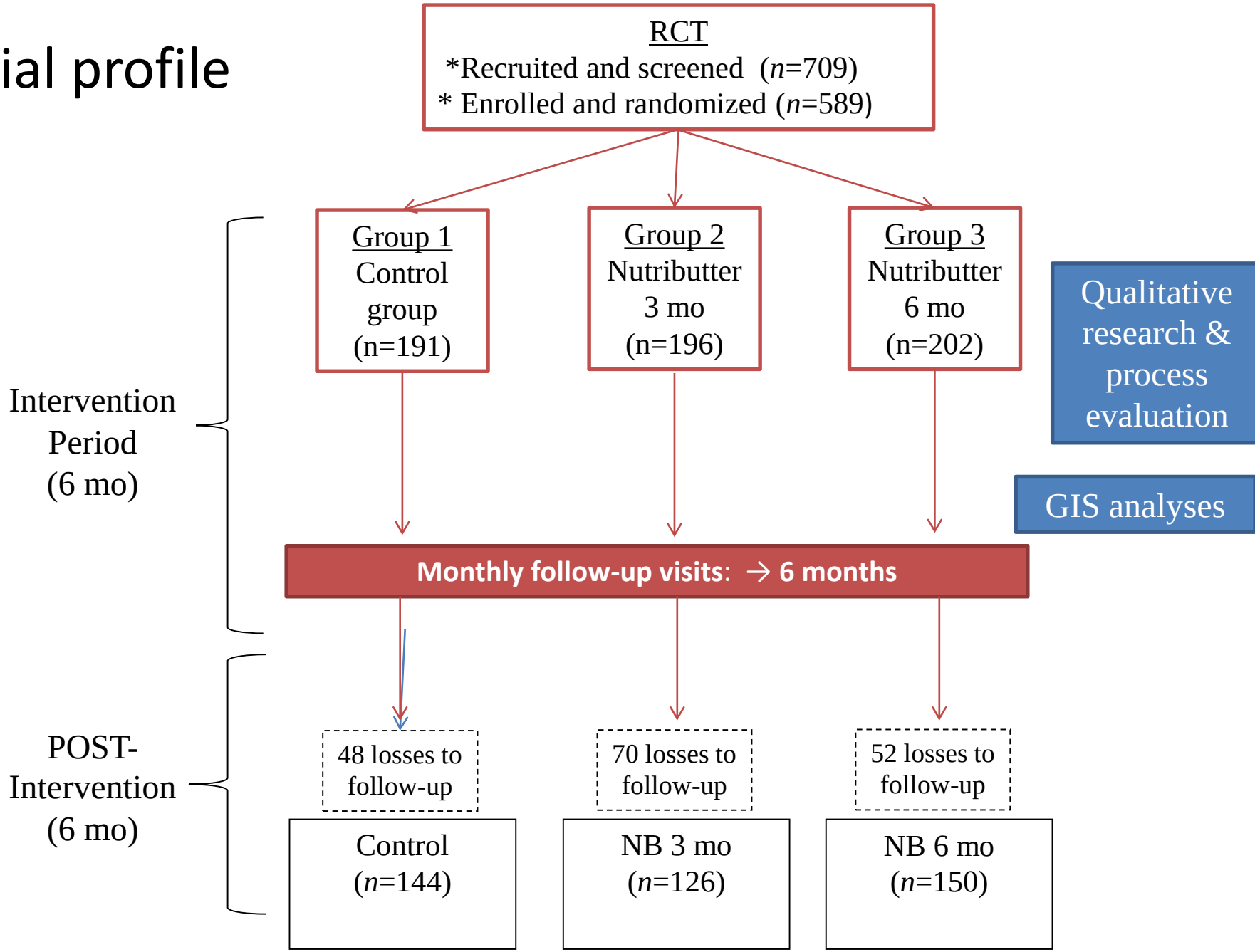
- **RCT & impact evaluation**
  - Control, 3-mo NB, 6-mo NB
  - Followed monthly for anthropometry, morbidity, and development outcomes
  - Sustained growth effect→ 6 mo post-intervention

- **Qualitative research & process evaluation**
  - In-depth interviews, matrix scoring, focus groups, observations, etc.
  - Logic model framework

- **Geospatial analyses**
  - Handheld Global Positioning System (GPS) units to map (n=150) of households, water sources, sanitation, markets, health service providers, churches

M. Kasparian photo, 2012

Trial profile



Qualitative Research

Intervention: Nutributter ®

Nutributter ®
Ingredients: peanut paste, sugar, vegetable fat, dry skimmed milk powder, maltodextrines, whey, vitamin and mineral pre-mix, emulsifier

Proportion of Daily Requirements Met per Serving Size of Nutributter

For infants aged 7-12 months

	for 20g (serving size)	Daily Recommended Requirement*	% of Requirement met
Energy	108 kcal	n/a	n/a
Proteins	2.6 g	11 g	24%
kcal %	9.5%	n/a	n/a
Lipids	7.1 g	n/a	n/a
kcal %	59%	n/a	n/a
Calcium	100 mg	270 mg	37%
Phosphorus	82.1 mg	275 mg	30%
Potassium	152 mg	700 mg	22%
Magnesium	16 mg	75 mg	21%
Zinc	4 mg	3 mg	133%
Copper	0.2 mg	0.22 mg	91%
Iron	9 mg	11 mg	82%
Iodine	90 µg	130 µg	69%
Selenium	10 µg	20 µg	50%
Manganese	0.08 mg	0.6 mg	13%
Vitamin A	0.4 mg	0.5 mg	80%
Vitamin C	30 mg	50 mg	60%
Vitamin B1	0.3 mg	0.3 mg	100%
Vitamin B2	0.4 mg	0.4 mg	100%
Vitamin B6	0.3 mg	0.3 mg	100%
Vitamin B12	0.5 µg	0.5 µg	100%
Folic acid	80 µg	80 µg	100%
Pantothenic acid	1.8 mg	1.8 mg	100%
Niacin	4 mg	4 mg	100%

* NOTE: This data (taken from the DRI reports, see www.nap.edu) presents Recommended Dietary Allowances (RDAs) in green and Adequate Intakes (AIs) in black

Interventions
MOH Integrated Package

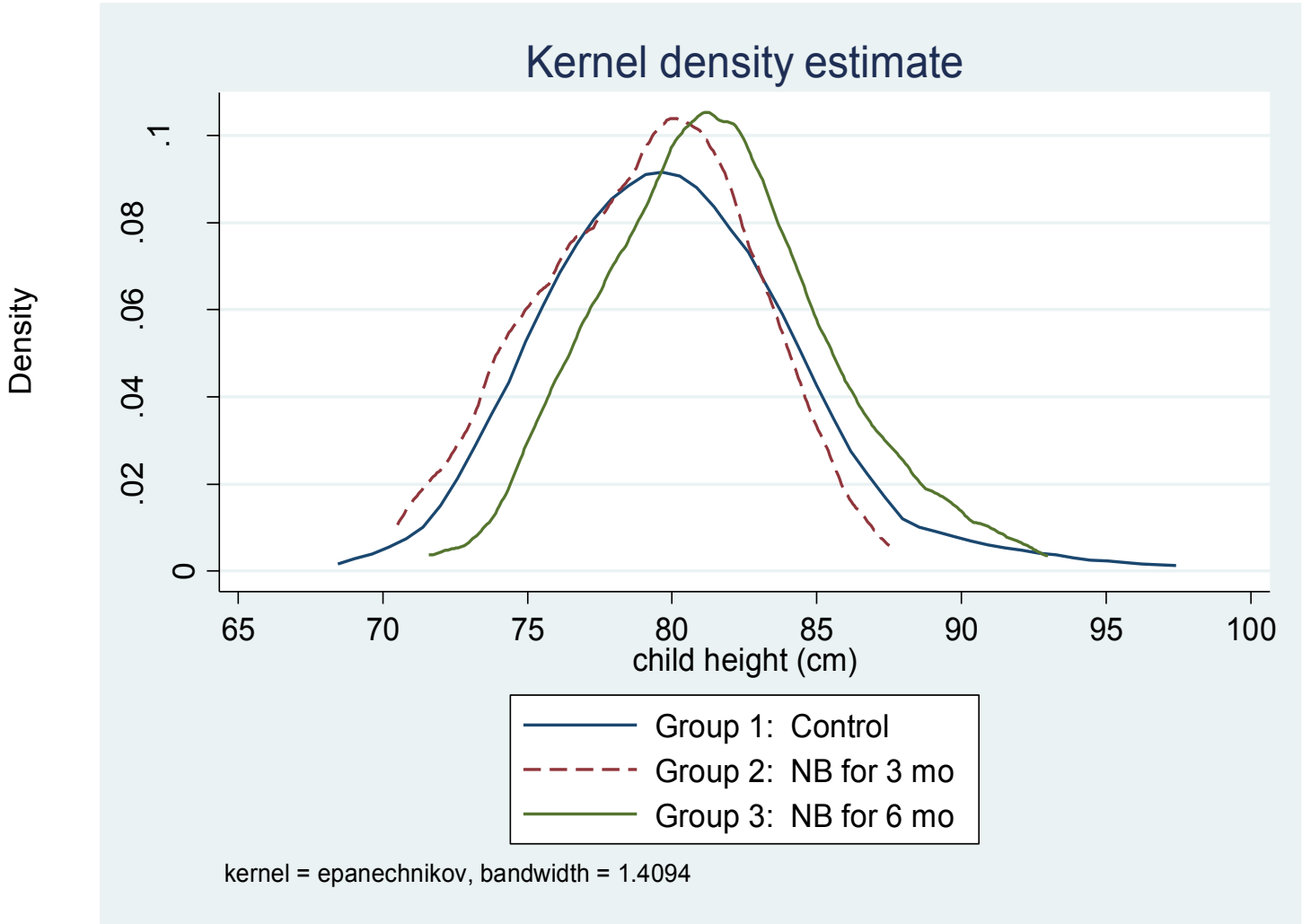
- Integrated Management of Childhood Illness (IMCI)
  - Health education: community health agents provide information at clinic & rally posts
  - Vaccinations
  - Vitamin A supplementation
  - Growth monitoring & promotion
  - Reproductive health

RESULTS

Growth effects – longitudinal regression

	3-mo NB vs. control				6-mo NB vs. control			
	Unadj β (SE)	P	Adj β (SE)[2]	P	Unadj β (SE)	P	Adj β (SE)[2]	P
At 6 mo								
LAZ	-0.10 (0.05)	0.06	-0.12 (0.05)	0.03	0.08 (0.05)	0.16	0.13 (0.05)	0.02
WAZ	0.02 (0.05)	0.65	0.01 (0.05)	0.86	0.08 (0.05)	0.09	0.12 (0.05)	0.02
At 12 mo								
LAZ	-0.09 (0.05)	0.06	-0.11 (0.05)	0.03	0.06 (0.05)	0.20	0.10 (0.05)	0.04
WAZ	0.03 (0.05)	0.54	0.02 (0.05)	0.73	0.08 (0.04)	0.09	0.11 (0.04)	0.02

Public health: entire distribution shifted



NB effects on IYCF

- Increased dietary diversity 0.23 ±0.07 SE ($P<0.001$)
- ↓ BF frequency 1.17 ±0.25 SE ($P<0.001$)
- ↑ water (84%) & sugar drinks (51%)

- Vitamin A supplementation
  - VAS in last 6 mo (99.3%)
  - 3-4 doses
  - 80% in NB groups >upper level

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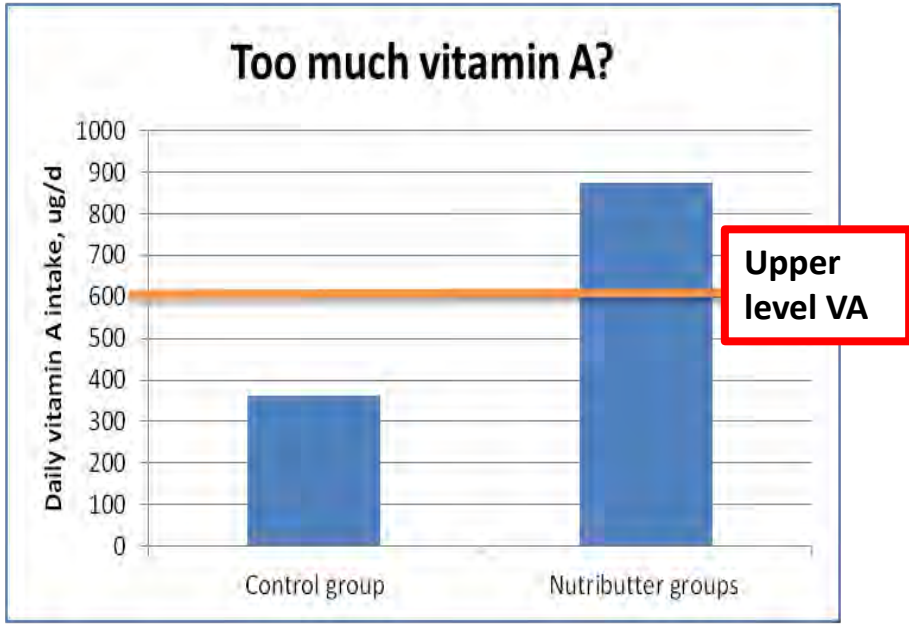

Implications

- Small-quantity LNS
  - NB for 6+ mo from 6-11 mo to promote linear growth
  - Offer NB with IMCI, but re-visit VAS protocols
- Deliver targeted IYCF messages
  - Breastfeeding: reduce poverty stigma, continued breastfeeding
  - Complementary feeding: re-enforce the mixing with other foods, safe drinking water consumption
- Research: next steps
  - Transdisciplinary approaches – public health, anthropology, engineering, and genomic sciences

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… the next 3,000 days

- **Brain development** – prefrontal cortex for higher cognitive functions; synaptogeneis and pruning; and neurogenesis in hippocampus (Grantham-McGregor et al. 2007)

- **Micronutrient deficiencies** - 20-30% of school-aged children have deficiencies in iron, iodine, zinc, and vitamin A (Best et al. 2011)
  - Haiti: 73% were anemic;14% were stunted; 9.1% thin; and low % fat mass boys (8%) and girls (12.5%)

- **School feeding programs** - largest investments in public food programs globally (Lentz & Barrett 2013)
  - Potential for local agriculture development & nutrition impacts (Iannotti et al. 2013)

Mamba School Feeding Project

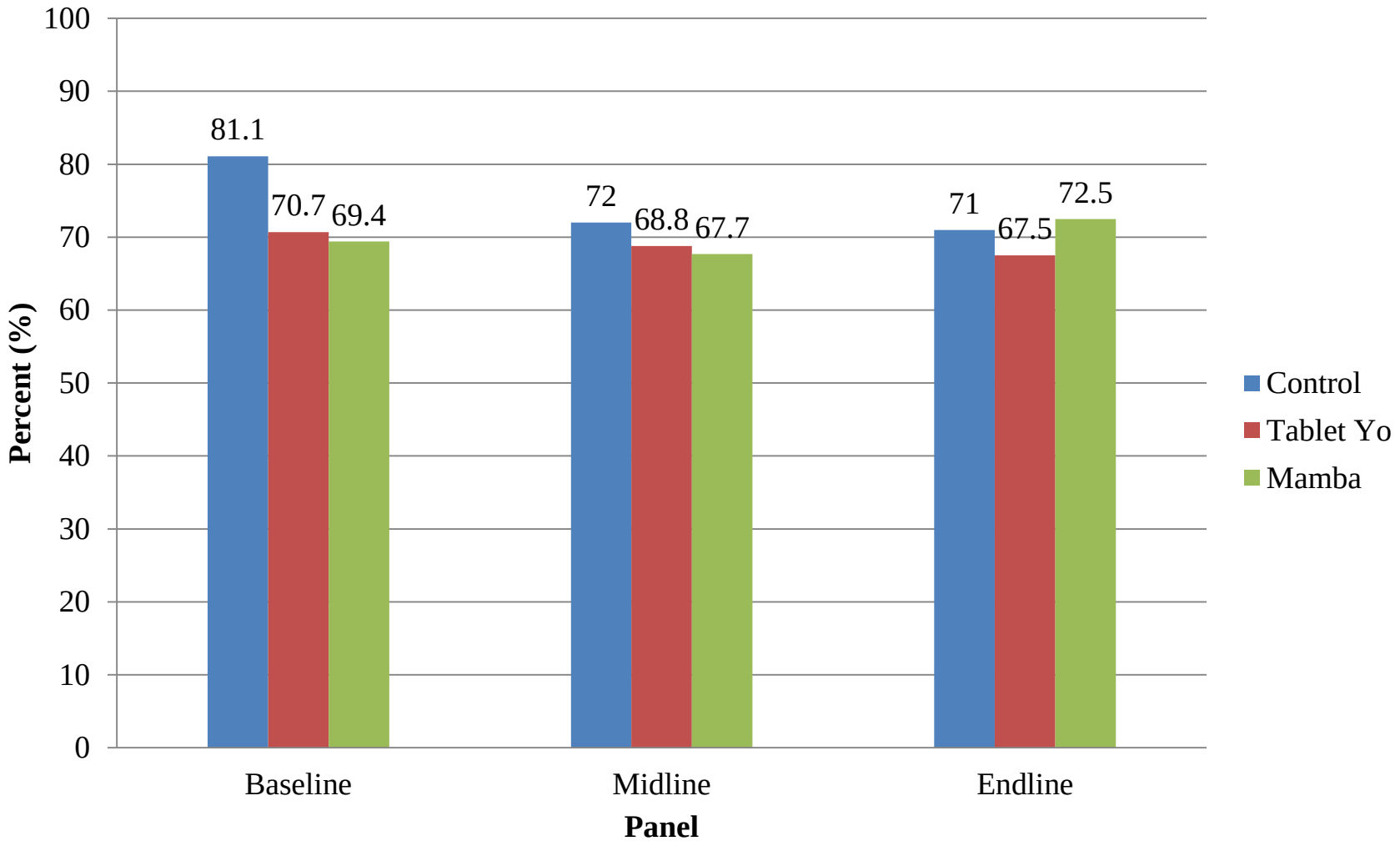
- McGovern-Dole International Food for Education and Child Nutrition
  - *Micronutrient-fortified food aid products pilot*

- Partners: Washington University, Edesia, National Soybean Research Laboratory, Ministry of Education/Haiti

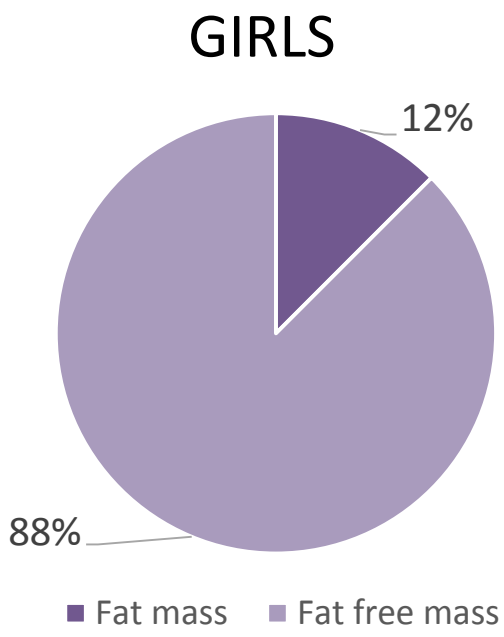
Design & Methods

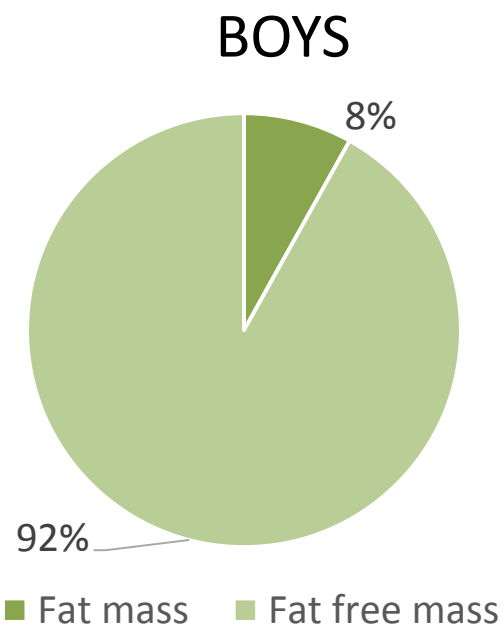
- Cluster-randomized controlled trial (quasi-experimental design)
  - Formative research/school profiles used to collect SES and nutrition to help match schools
- Sample & comparison groups (6 schools):
  - 1,200 school aged children 3-13 years
  - 1) control; 2) Tablet Sereyal (unfortified biscuit); 3) Mamba
- Impact & Process Evaluation
  - Impact outcomes – anemia, BIA, anthropometry, school attendance
  - Process outcomes – food acceptability, functionality, feasibility

High anemia prevalence, with limited RUSF impacts in urban context



% Fat Mass (baseline)





Gambia (5-13 yrs): girls (17-18%), boys (11-14%)
U.S. (5-18 yr): girls (15-24%), boys (14-18%)
Germany (3-18 yr): girls (18-20%), boys (15-20%)

Importance of body fat

- Brain development and metabolism (Murray et al. 2012)

- Thinness in school children associated with ↑infectious disease, anemia, impaired cognitive/motor development (Heath & Taylor 2012)

- White adipose tissue – immunity, reproduction, and glucose/lipid metabolism; Brown adipose – regulates body temperature (Fruhbeck et al. 2013)

Mamba increases BMIz, fat mass, & %fat mass

TABLE 5 Longitudinal regression models of intervention effects in Haitian school children

	BMI *z* score[1]		Fat mass,[2] kg		Fat mass,[2] %	
	Group effect (n = 2329)	Mamba effect (n = 1479)	Group effect (n = 2460)	Mamba effect (n = 1565)	Group effect (n = 2269)	Mamba effect (n = 1441)
Group effect (Mamba = 3; Tablet Yo = 2; control = 1)						
Coefficient ± SEE	0.12 ± 0.03	—	0.21 ± 0.06	—	0.64 ± 0.13	—
P	<0.001	—	0.001	—	<0.001	—
Mamba effect (Mamba = 2; control = 1)[3]						
Coefficient ± SEE	—	0.25 ± 0.06	—	0.45 ± 0.14	—	1.28 ± 0.27
P	—	<0.001	—	0.002	—	<0.001
R^2 overall	0.07	0.08	0.15	0.14	0.24	0.23
Wald chi^2	177.17	130.00	403.82	229.66	732.41	431.31
$P < chi^2$	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

[1] Generalized least squares regression with random effects adjusted for age of the child, maternal BMI, monthly income, and school cluster.
[2] Generalized least squares regression with random effects adjusted for age of the child, sex of the child, maternal BMI, monthly income, and school cluster.
[3] A separate model was generated to examine the Mamba effect compared to control only, excluding the Tablet Yo group.

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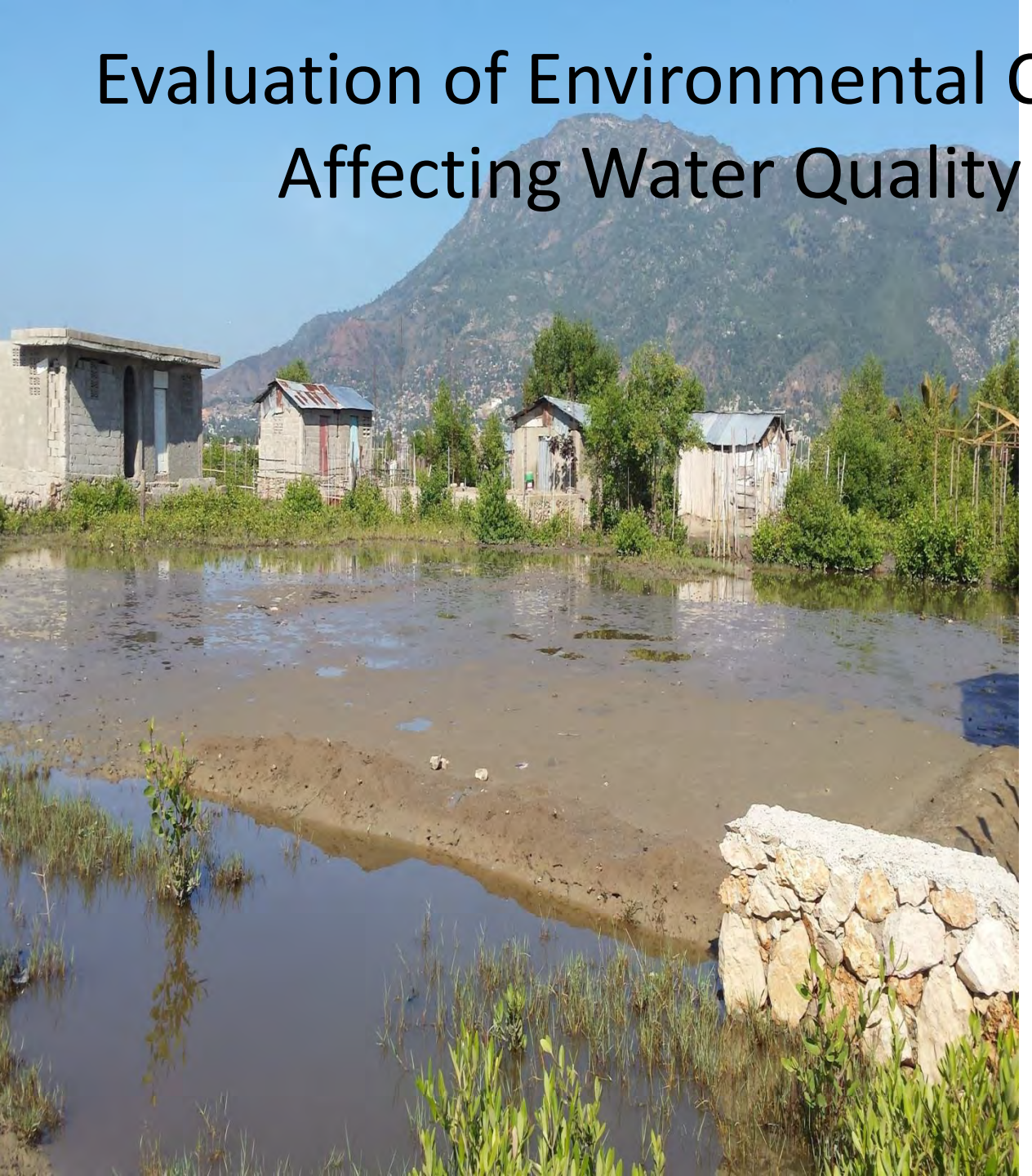
Conclusions

INTEGRATED NUTRITION PROGRAMMING

Evaluation of Environmental Contaminants Affecting Water Quality in Haiti



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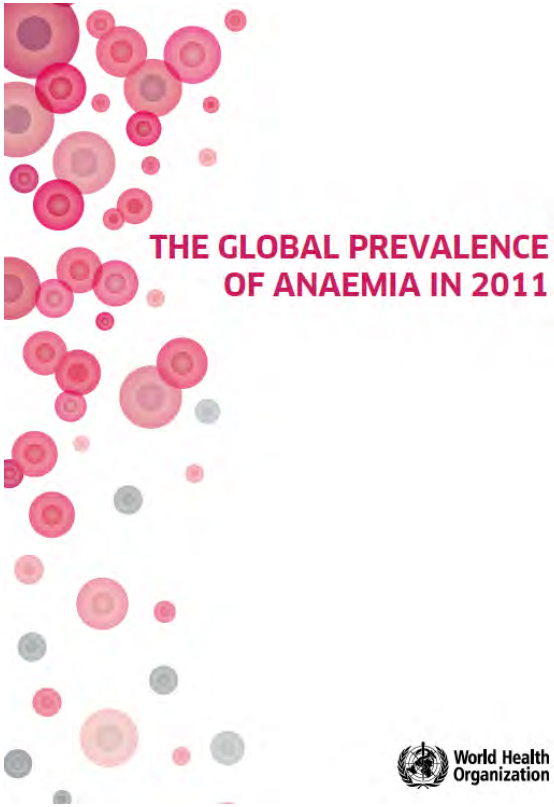
Anemia

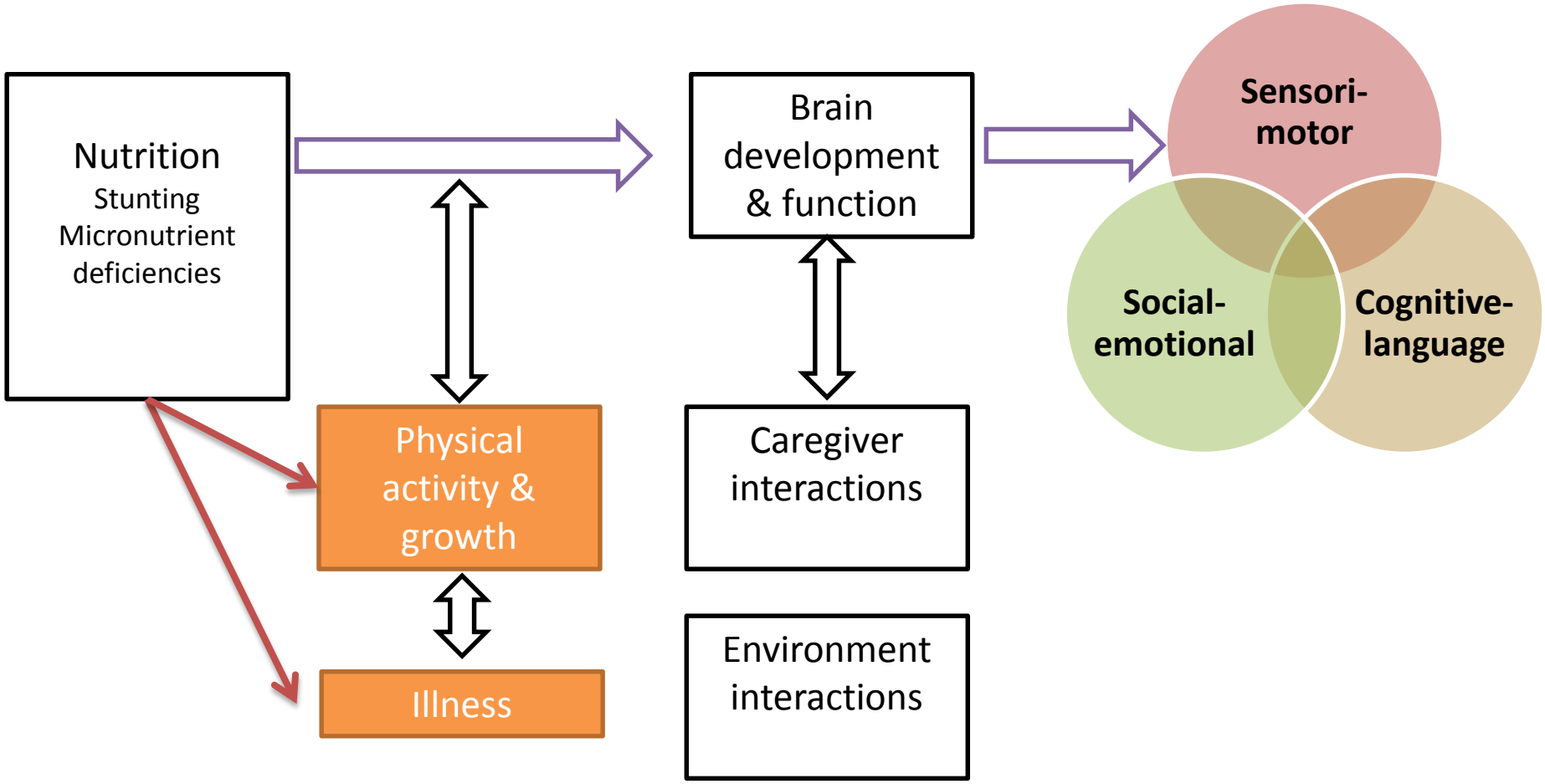
- **Blood disorder**
  - Reduced concentration of hemoglobin in the blood
  - Consequences: weakness, fatigue; compromised cognitive and physical development in young children, poor birth outcomes in pregnant women, and in severe cases, increased risk of mortality in certain populations (Hoffbrand et al 2006)
- **1.62 billion people (95% CI: 1.50-1.74 billion)**
  - 64.8 million disability adjusted life years (DALYs).



ANEMIA CAUSES

- **nutritional deficiencies** (iron, vitamin A, vitamin B_{12}, folate, riboflavin, and copper);
- **infection** (malaria, helminths, tuberculosis, HIV);
- **chronic disease** (cancers);
- **blood loss** (hemorrhage during delivery, injury);
- **hemoglobinopathies** (thalassemia, sickle cell anemia)

Pathways: from nutrition to child development



Conclusions

- Limiting nutrient deficiencies
  - LNS, RUSF (VitaMamba) early and do no harm ethic
  - Improve diet quality
- Prevention strategies
  - 1,000 days (IYCF, maternal nutrition)
  - 3,000 days (development, body com
- Integrated programming dependi on context
  - WASH
  - Poverty alleviation
  - Agriculture
  - Education