GEORGE WARREN BROWN SCHOOL of Social Work

Animal Source Foods: importance nutritionally &

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TOPS Program

Nutrition/Food Technology Task Force &

Agriculture/Natural Resource Task Force

Washington University in St. Louis

Presentation outline

1) **Animal source foods: vital role in human nutrition**
   - Stunting & hidden hunger
   - ASF matrix - bioavailability of critical nutrients

2) **Eggs, Milk, and Fish: research**
   - Egg nutrition among indigenous groups – Ecuador
   - Milk nutrition among pastoralists – Kenya
   - Fish nutrition - Haiti

3) **TOPS Program**
   - Nutrition/Food Technology Task Force
   - Agriculture/Natural Resource Management Task Force

Undernutrition in first 1,000 days…

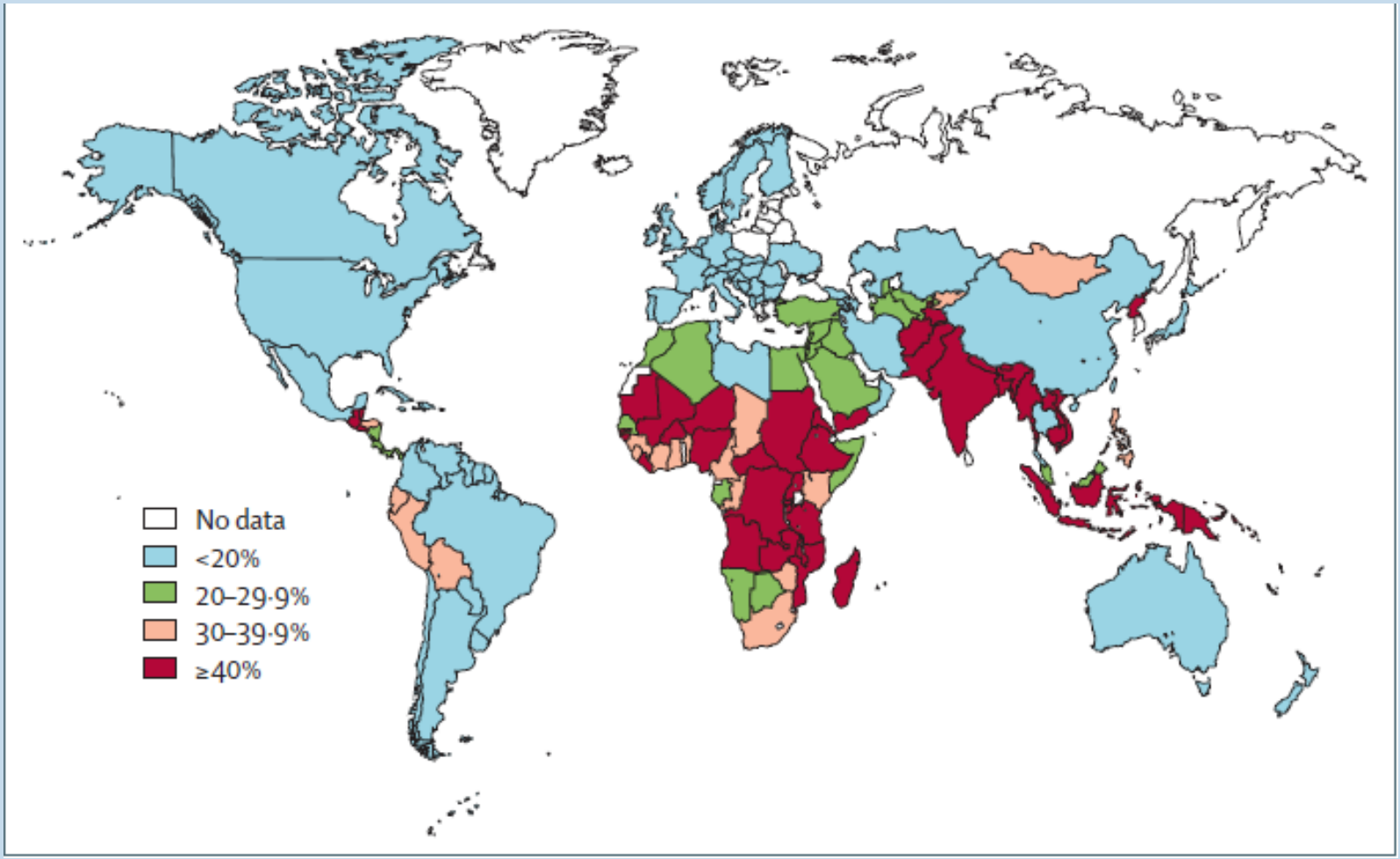
- **Undernutrition** in young children < 5 yrs
  - 164.8 million stunted (25.7%)
  - 100.7 million underweight (15.7%)
  - 51.5 million wasted (8%)

- **Hidden hunger** – micronutrient deficiencies
  - 33% children vitamin A deficient
  - 18% children anemic (some iron deficiency)
  - 17.3% world zinc deficient; 28% world iodine deficient

3.1 million (45%) of deaths to children <5 yr (2013)

140.5 million (35%) of DALYs for children < 5 yr and 10% of global DALYs (2008)

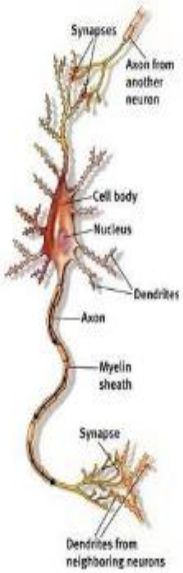
Prevalence of Stunting

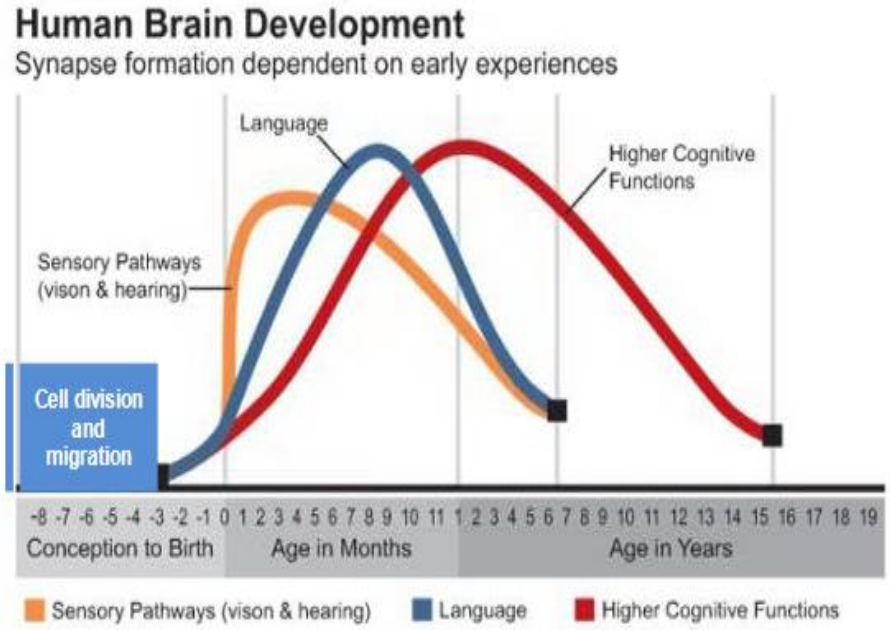


Black et al. Lancet 2008

Next 3,000 days: ASF for healthy brains

Sensitive periods and the developing brain





THE LANCET

Advancing Early Childhood Development: from Science to Scale

Global Nutrition Targets 2025

ASF CONTRIBUTION

1) Stunting →

2) Anemia →

3) Low birthweight→

TARGET	BASELINE 2012	TARGET FOR 2025
1 40% REDUCTION IN THE NUMBER OF CHILDREN UNDER-5 WHO ARE STUNTED	162 million	≈100 million
2 50% REDUCTION OF ANAEMIA IN WOMEN OF REPRODUCTIVE AGE	29%	15%
3 30% REDUCTION IN LOW BIRTH WEIGHT	15%	10%
4 NO INCREASE IN CHILDHOOD OVERWEIGHT	7%	≤7%
5 INCREASE THE RATE OF EXCLUSIVE BREASTFEEDING IN THE FIRST 6 MONTHS UP TO AT LEAST 50%	38%	≥50%
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Food Matrix & Evolutionary Basis

RATIONALE FOR ANIMAL SOURCE FOODS

Essential Nutrients

- Constituents in the diet required for growth, health, and survival, not sufficiently produced endogenously.
  - Macronutrients – protein/amino acids, carbohydrates, lipids/fatty acids, fiber
  - Micronutrients
    - Vitamins (organic) – A (β-carotene, retinol), B (thiamin), riboflavin, niacin, pyridoxine, cobalamin, pantothenic acid, folate), C (ascorbic acid), D (calciferol), E (α-tocopherol), K, choline
    - Minerals/elements/trace minerals (inorganic) – calcium, iron, zinc, iodine, selenium, copper, fluoride, phosphorus, magnesium, manganese
  - Water & electrolytes – sodium, chloride, potassium, inorganic sulfate

Single nutrient versus food matrix

Historical origins

- Nutrient discoveries in relation to disease – scurvy (vit C), beri beri (thiamine), rickets (vit D), goiter (iodine)
- Technologies that enable supplementation, fortification and biofortification

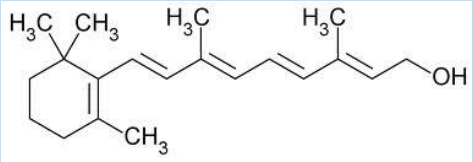
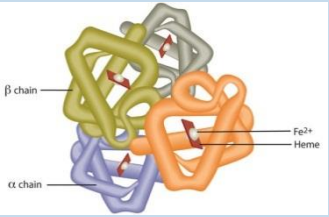
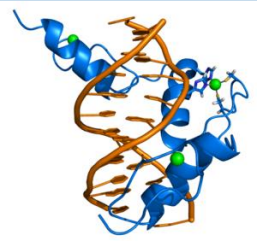
Global nutrition programming and policy

- Vitamin A supplementation
- Fortification (iodized salt, folic acid in wheat) and biofortification (golden rice, orange flesh sweet potatoes)

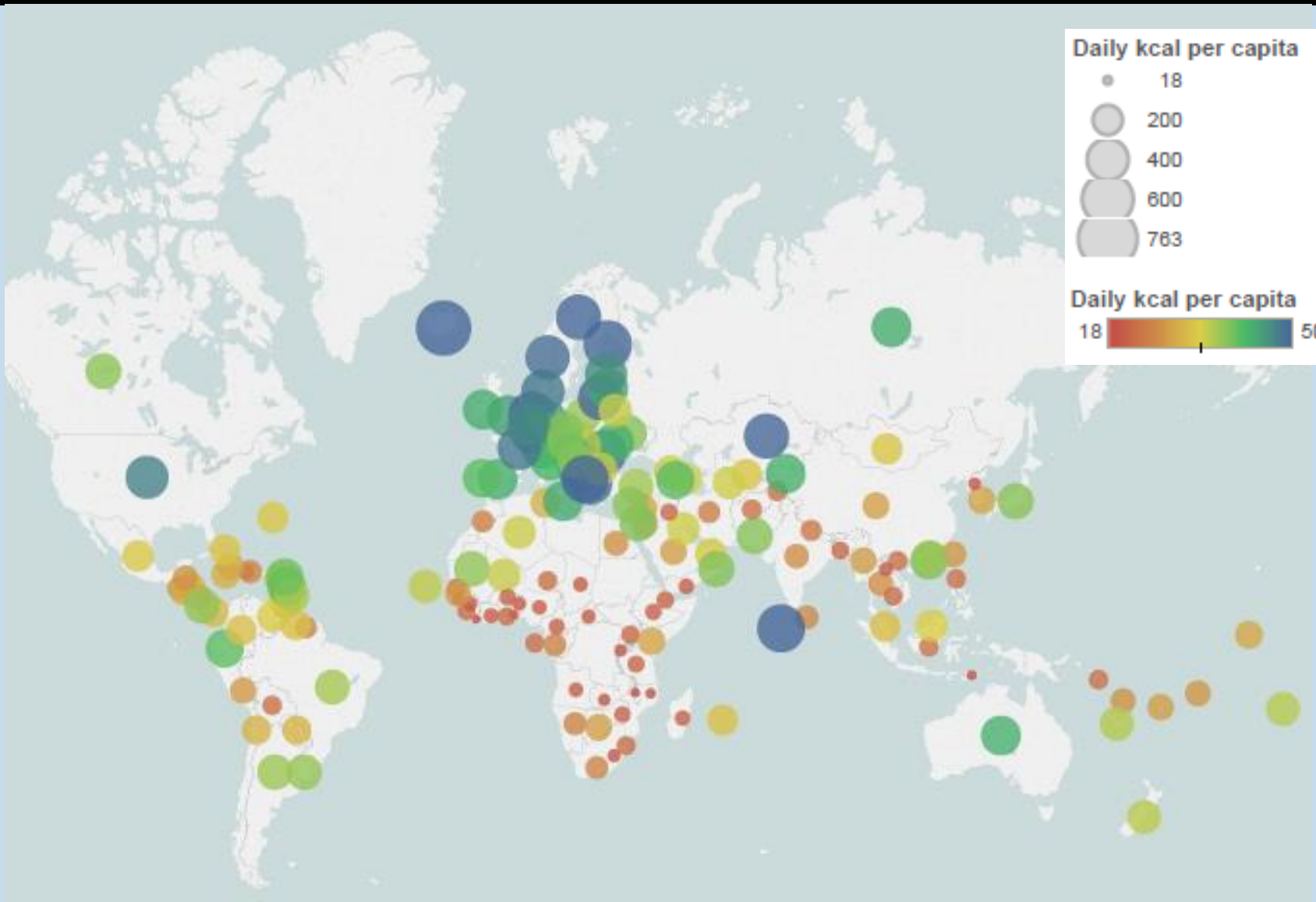
What is the harm?

* Potential for overload
* Physiology not constituted for single nutrients

Food matrices: it's all in the packaging

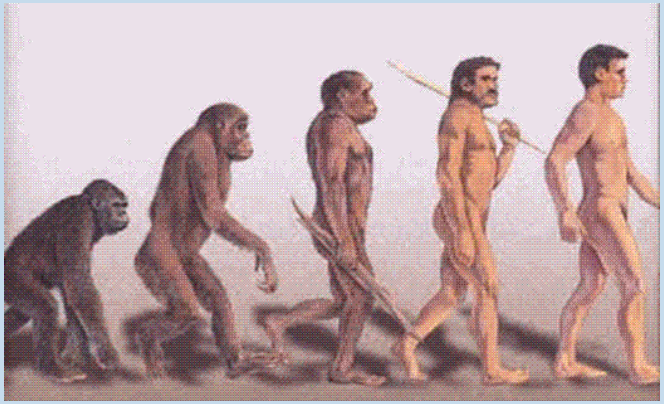
Limiting nutrient	ASF matrix	ASF:plant form absorption rate
Vit A →		12-24x (ug)
Iron →		2x (mg)
Zinc →		2x (mg)
Choline →		

Global distribution of eggs, milk, & fish availability
(FAO data 2011)



Evolutionary basis: anthropology of anthropometry

- Homo erectus (2.6 mya)
  - Differed from Australopithecus garhi & Homo habilis
  - Bigger brain & body
  - Smaller intestine & teeth



- Agriculture (10,000 ya)
  - Mobility no longer necessary
  - Homo sapiens shorter

- Genome-Nutrition Divergence
  - *Discordance theory* (Konner & Eaton 1*985)* Human genome evolve to adapt to conditions that no longer exist. Mismatch is causing chronic diseases

Leveraging Nature's Technology: eggs & milk

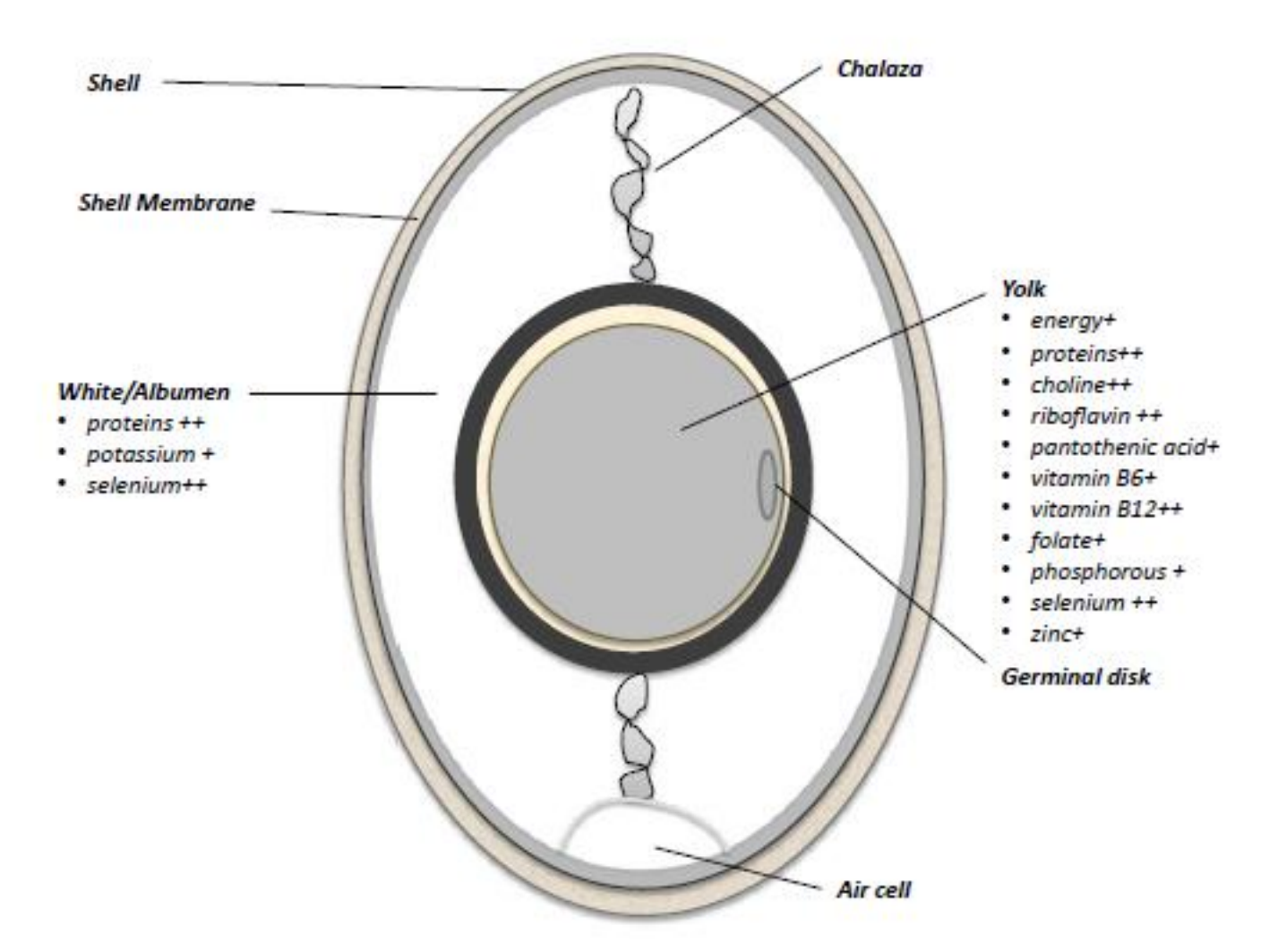
Over thousands of years…

1) nature perfected the nutritional composition

2) crafted to sustain early life, completely

3) economically affordable and environmentally sustainable

Eggs: provides >50% of nutrients (++) and 20-50% (+) for breasfed infants 7-12 mo



Iannotti et al. *Nutrition Reviews* 2014

Lulun Egg Project – Ecuador

G. Reinhart photo, Mathile Institute

Lulun Egg Project

- **Objective:** Test the efficacy eggs introduced early in complementary feeding period on growth and nutrient biomarker outcomes (n=163)
  - **Primary outcomes**: biomarkers of choline, vitamin B_{12}, and fatty acids, anthropometry/growth
  - **Secondary outcomes**: acceptability, dietary intakes, and morbidities

Lulun Egg Project

- RCT (Mar–Dec 2015)
  - **Cotopaxi Province –** mixed indigenous community, high baseline stunting
  - **Intervention**: 1 egg per day for 6 months (eggs purchased locally, and delivered weekly during surveillance visits)
  - **Longitudinal follow-up:** baseline (6-9 mo) and endline (12-15 mo)

- Mixed methods
  - **Quantitative**: caregiver surveys, anthropometry, GPS/GIS
  - **Biomarkers**: LC/MS/MS at Washington University in St. Louis, ELISA (vitamin B12) at NETLAB
  - **Qualitative**: grounded theory, structured observations, focus groups, and in-depth interviews

Social Marketing

- **Intent:** *encourage participation* with culturally inclusive messages and symbols, and *create awareness* about the study and its importance

- **Activities:** messaging at study site and community; workshops (egg recipes, flower arranging); sports; community events

- **Successes:** RCT individual level; high participation; only 7% losses-to-follow-up, despite Cotopaxi volcano eruption.

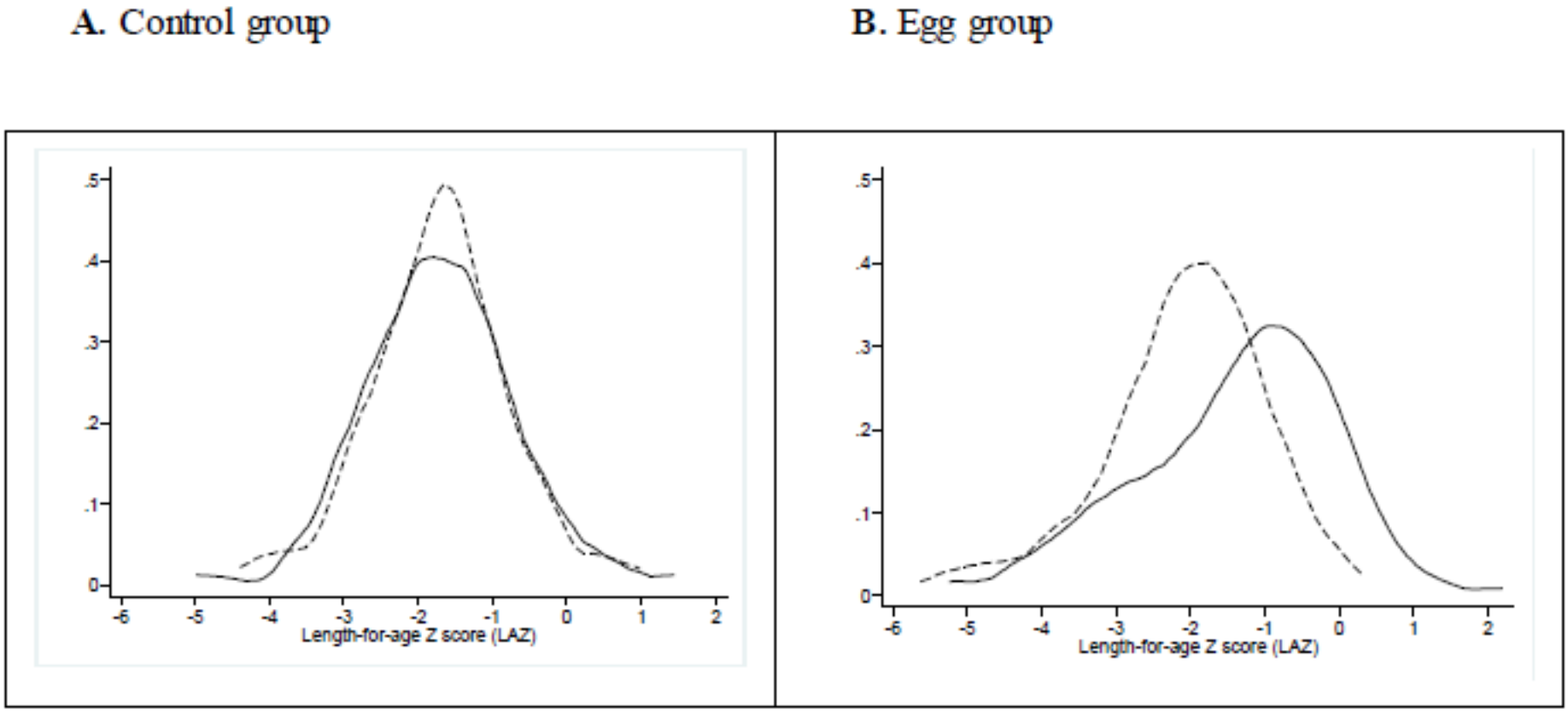
GLM regression models

	Baseline		Endline		Effect size or prevalence ratio	
	Control (n = 82)	Egg (n = 78)	Control (n = 73)	Egg (n = 75)	Adjusted[a]	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	β (95% CI)	P
Length-for-age z (SD)	-1.71 (0.92)	-2.09 (1.08)	-1.71 (1.00)	-1.39 (1.35)	0.63 (0.38-0.88)	<.001
Weight-for-age z (SD)	-0.40 (0.92)	-0.91 (1.24)	-0.55 (0.85)	-0.34 (1.06)	0.61 (0.45-0.77)	<.001
Weight-for-length z (SD)	0.86 (0.99)	0.55 (0.99)	0.36 (0.81)	0.45 (0.84)	0.33 (0.14-0.51)	<.001
BMI z (SD)	0.80 (1.00)	0.42 (1.10)	0.64 (0.82)	0.68 (0.86)	0.29 (0.08-0.49)	.006
	%	%	%	%	PR (95% CI)[b]	P
Stunted	26 (32%)	37 (47%)	29 (40%)	21 (28%)	0.53 (0.37-0.77)	.001
Underweight	4 (5%)	10 (13%)	5 (7%)	4 (5%)	0.26 (0.10-0.70)	.008

GLM modeling with log-binomial with robust Poisson for stunting and underweight outcomes. All models adjusted for child age, sex of the child, and baseline anthropometry for the same dependent variable.

Growth Effect:

Change in LAZ, baseline (dashed) to endline (solid)



Kernel density estimates

Other key findings

- No allergic reactions to eggs (observed or mother-reported)
- Reduced intake of sugar-sweetened foods (PR, 0.71; 95% CI, 0.51-0.97)
- Increased concentrations of choline, betaine, and dimethylglycine
  - No effect on vitamin B12, linoleic (18:2n-6), α-linolenic (18:3n-3), or DHA fatty acids

Pastoralist milk nutrition: Kenya

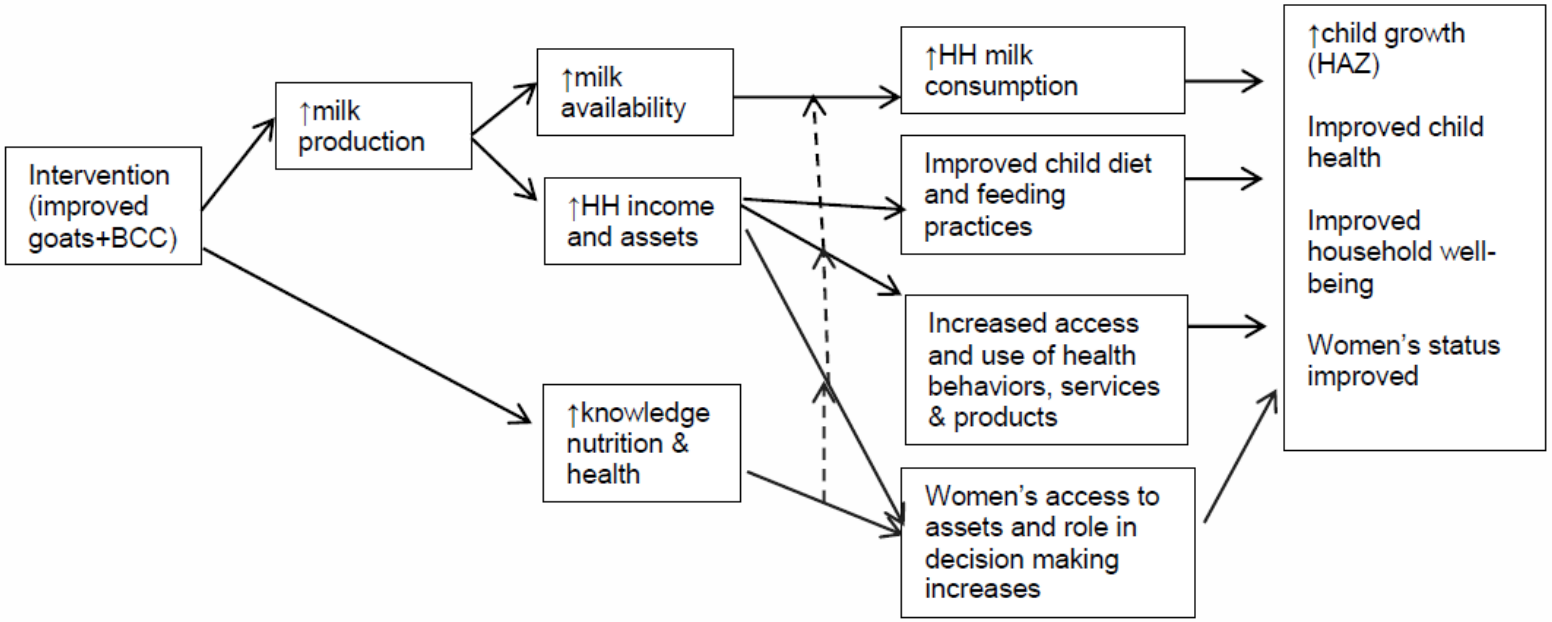
Pathways to nutrition impacts

Livelihood transition: ↓ Land access & ↑ Sendentarization

2 comparable communities: livestock (Siambu); Mbaringon: cultivation

Longitudinal data - 2000, 2005, 2010, 2012

Figure 9: Causal Pathways



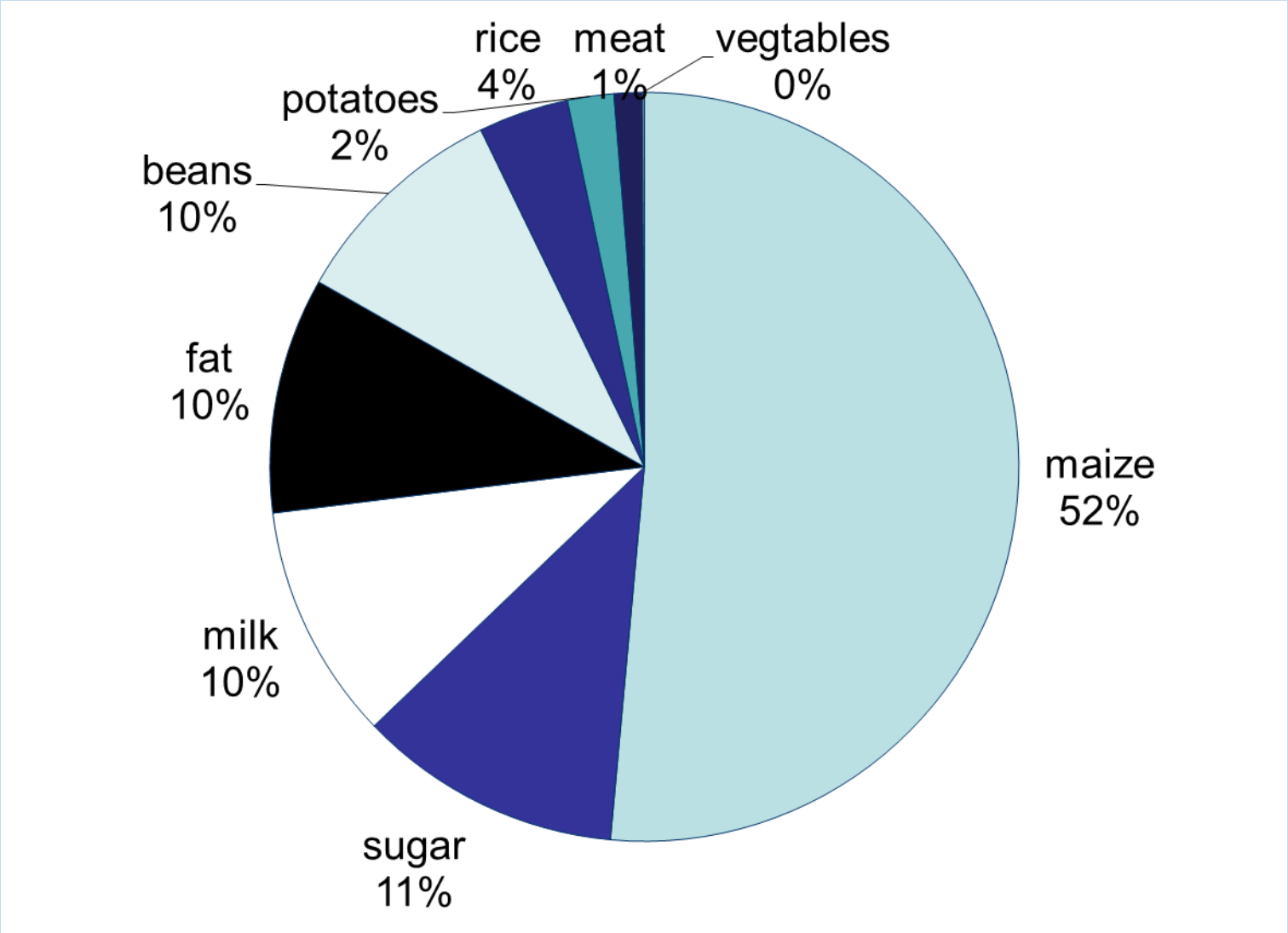
Food source of nutrients

Table 3. Food group source of nutrients (%), 2010

	Energy	Vitamin A	Vitamin B_{12}	Vitamin C	Folate	Iron	Zinc
Maize	49	34	0	0	27	60	51
Rice	5	0	0	0	7	5	13
Potatoes	2	0	0	33	2	3	1
Beans	11	0	0	0	57	27	21
Meat	1	0	6	0	0	2	3
Milk	10	57	94	50	6	2	11
Vegetables	0	9	0	17	1	1	0
Fat	9	0	0	0	0	0	0
Sugar	13	0	0	0	0	0	0

Iannotti and Lesorogol CA 2014

Maize dependency - % daily kcals



Livestock ownership improves nutrient intake

- **Findings:**
  - Livestock ownership increased nutrient adequacy for vitamin A, B_{12}, and zinc (adj R^2=.06-.16; P<.001) (Iannotti and Lesorogol *CA* 2014)
  - Milk consumption increased BMI z scores among youth (P<0.001) (Iannotti and Lesorogol *AJPA* 2014)
  - Cattle and chicken ownership increased dietary diversity (adj R^2=.33; P<.001)

- **Conclusion:**
  - Support livestock development among pastoralist households for child milk consumption and nutrition

- **Next steps:**
  - Intervention study to examine improved breeds and managements of goats on: milk production and poverty reduction; milk consumption, nutrition, and health; and gender empowerment.

Fish nutrition: Haiti

Environment & nutrition

- **Low fish consumption in Haiti**
  - Stunting 20.9% < 5 years
  - Fish source of DHA, n-3 fatty acids
  - ↓Fish consumption per capita,

  2.8-4.8 kg/yr

- **Mangroves & other environmental Issues**
  - Mangroves cut down for impounding land, charcoal, and fire wood
  - Overfishing, depletion of coastal waters; barrier reef destruction erosion
  - Juvenile fish and conch sold in markets

Protecting the mangroves for fish nutrition

- **Haiti fish potential**
  - Island with 2 penisula, >1700 km total coastline
  - Promote fish and mollusk consumption for young children
- **Protecting Mangroves**
  - Universite d'Etat d'Haiti – Department of Environment
  - Important marine life nurseries [mollusks/conch, crustaceans, eels, fish]
- **Formative research**
  - Data analyses of fish consumption and stunting
  - Focus groups, in-depth interviews of fisherman, market women (madan sara), and mothers

Programming Agenda

TOPS TASK FORCE

Global Nutrition Targets 2025

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Leverage ASF Potential

- **Nutrition/Food Technology Task Force**
  - Introduce ASF early in the complementary feeding period
  - Promote WASH in context of animal production
  - With increased income, encourage high quality foods
- **Agriculture/Natural Resource Management Task Force**
  - Small livestock and fisheries development beyond production threshold for selling
  - Protect animal health and nutrition to improve human nutrition
  - Preserve environment to protect nutrition
- **Find transdisciplinary solutions! (and evaluate for evidence base)**

THANK YOU