

# The Search for Agriculture based Solutions for Childhood Malnutrition



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# Outline

- Has nutritional status in Bangladesh improved?
- Why are agriculture based interventions important to control malnutrition?
- Examples of research linking agricultural interventions to good health and nutrition

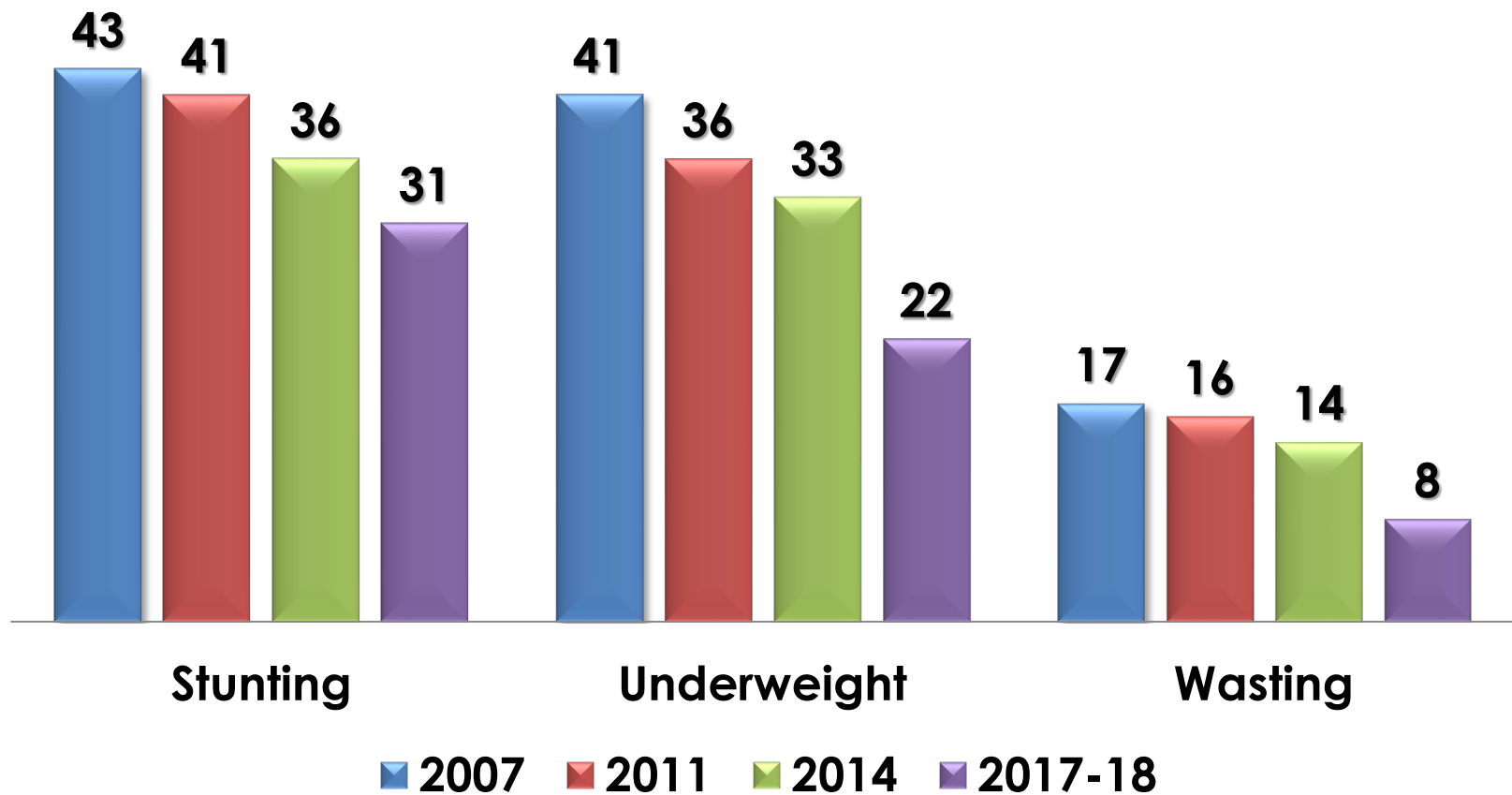
# Stunting a major childhood problem globally

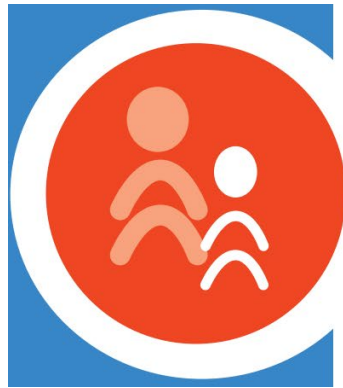


Linear growth retardation  
Low height-for-age

# Childhood malnutrition in Bangladesh

Percentage of children under 5 based on WHO growth standard 2006





# REDUCING STUNTING IN CHILDREN

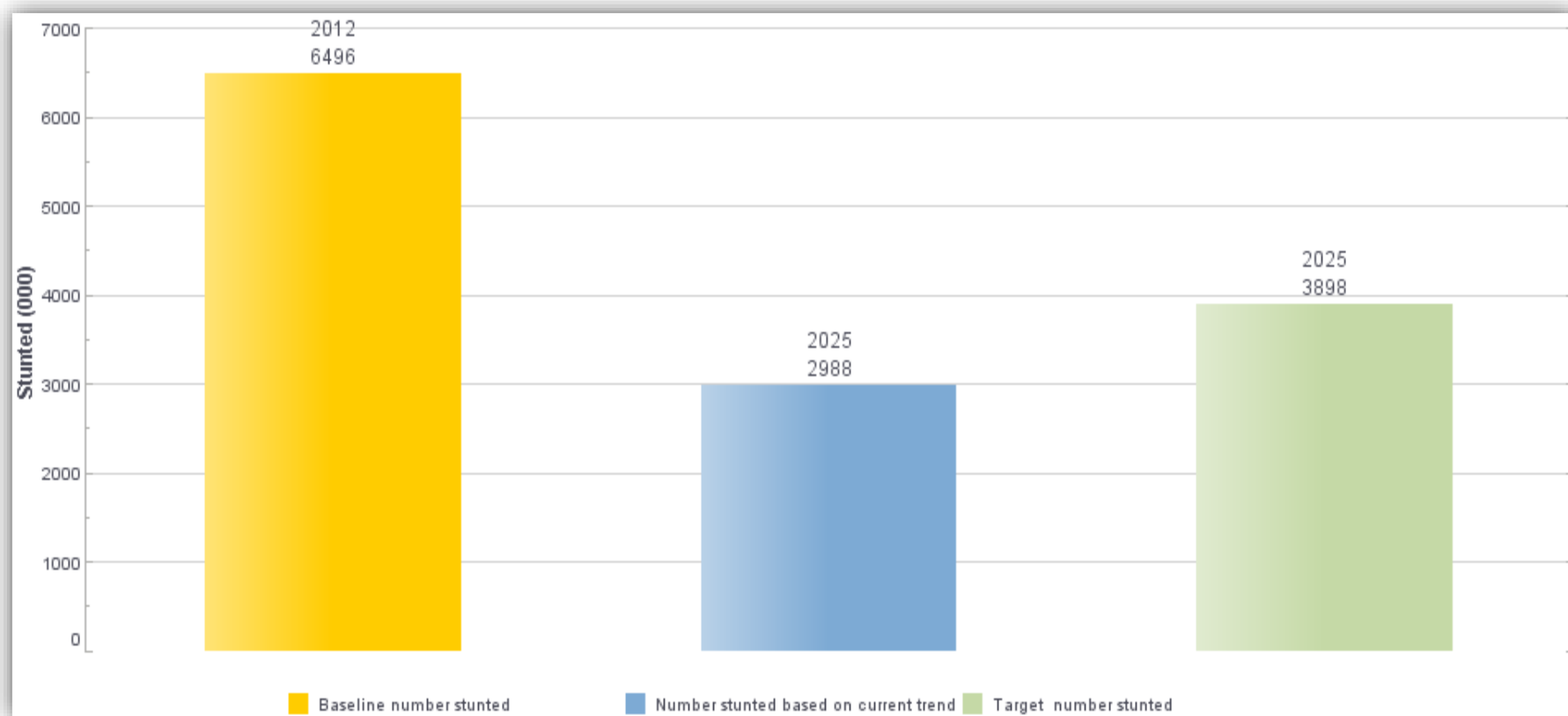
**TARGET:** 40% REDUCTION IN THE  
NUMBER OF CHILDREN UNDER-5  
WHO ARE STUNTED

**Equity considerations**

for **achieving** the

**Global Nutrition Targets 2025**

# Trends in stunting rates for Bangladesh





Date of Birth : 28 February, 2010



January 1, 2012



December 5, 2012

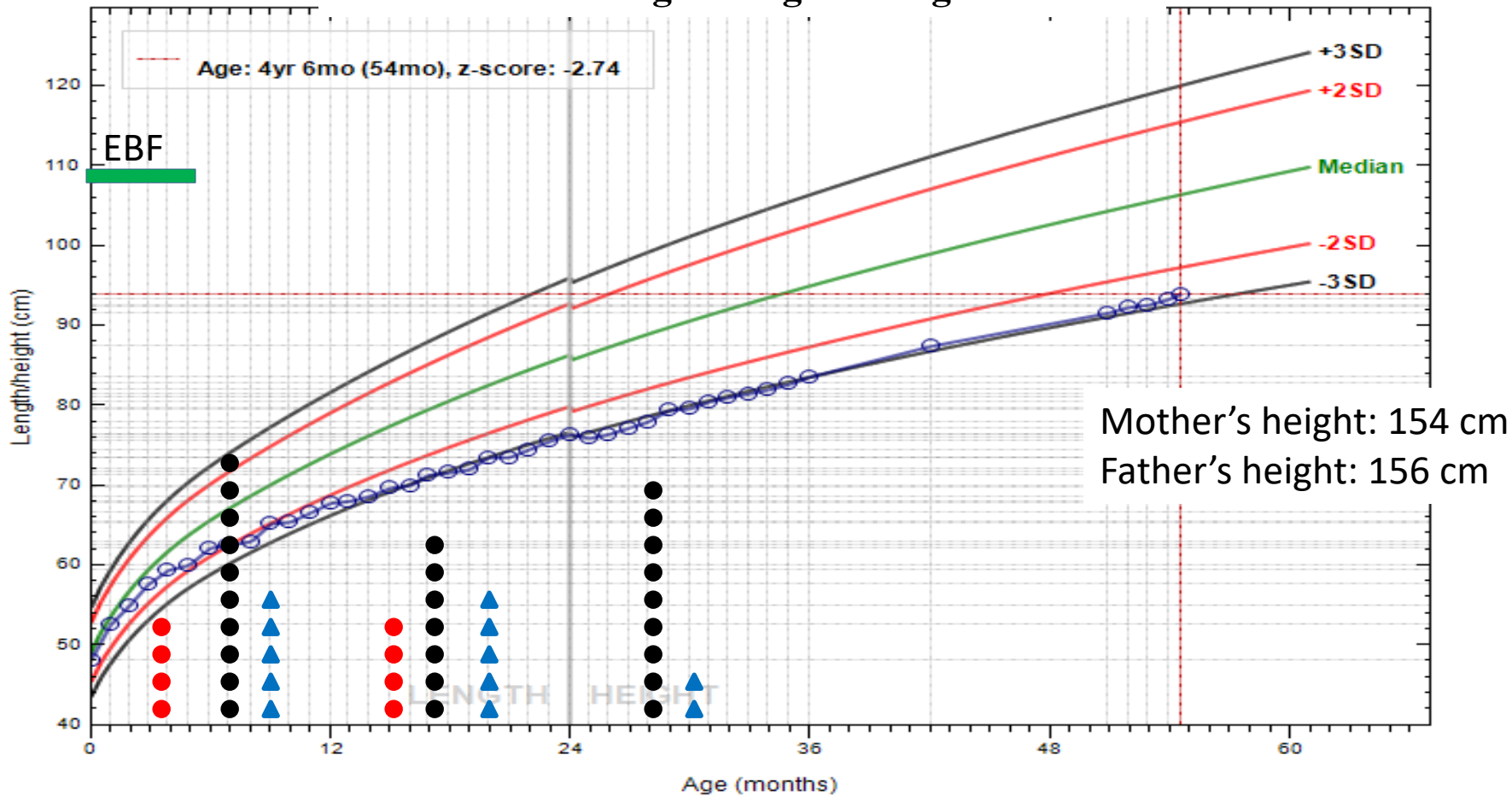


September 2, 2013



September 15, 2014

# Shrabonti: Length/Height for age z score

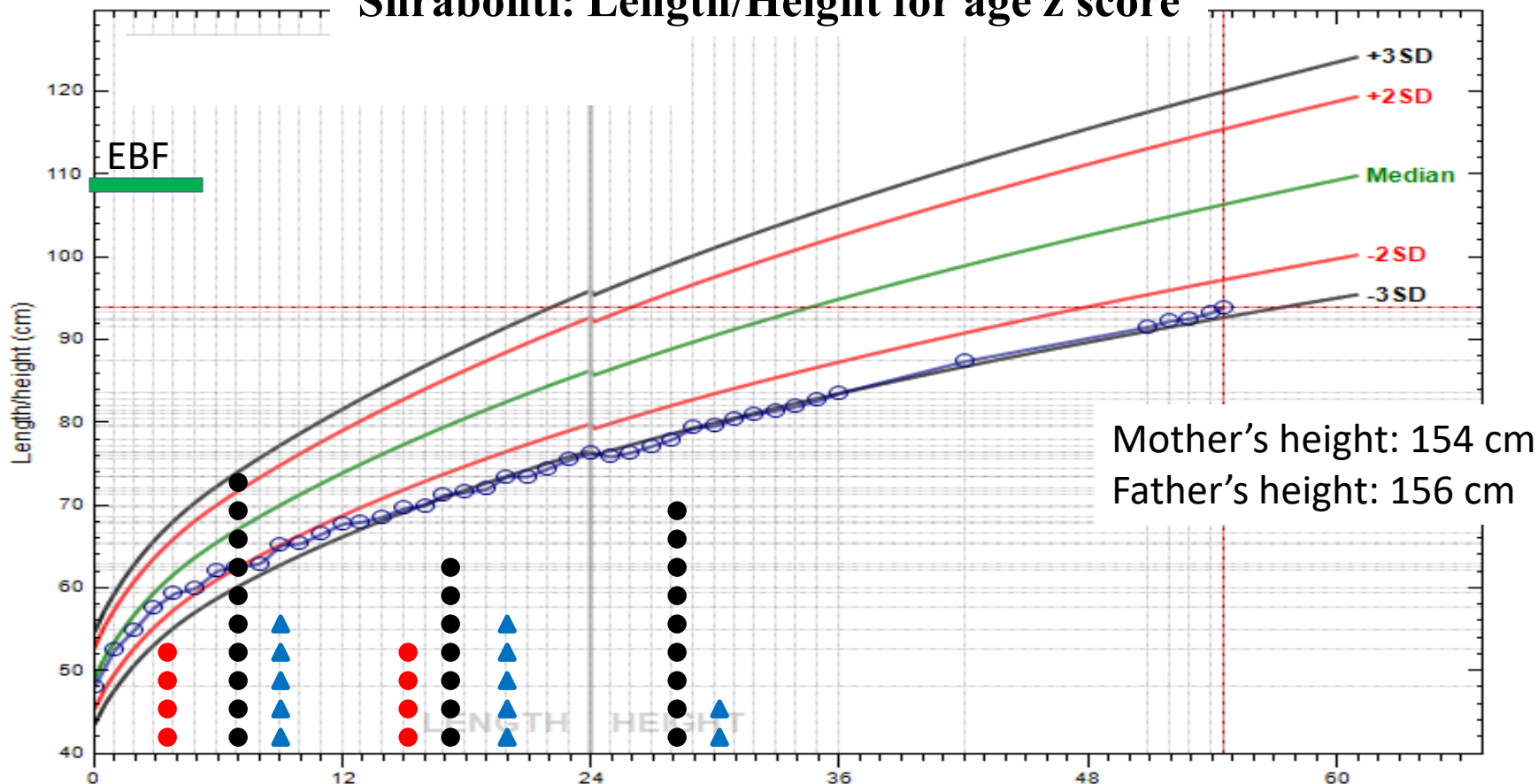


Major Food Group	Number of food intakes last 24 Hour																																			
	-----Month-----																																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	33	36				
Condiment									1		2				1	1		2		2																
Breast milk	11	10	10	12	14	15	15	19	13	11	13	11	12	13	13	13	10	9	12	11	13	10	14	12	10	9	10	11	9	12	9	7				
Fruit										1		1			2	1			1		1	1		1	1	1	1	1	1		1					
Legume										1	1	1	1	1		1						1	1	1				1	1							
Beef									1																1						1					
Chicken															1																1					
Fish														1	1	1	2	1		1	1				1	1	1				1					
Egg															1				2	1		1	1			1	1	1			1	2				
Starch									2	3	2	5	2	3	3	4	4	3	3	3	2	2	3	1	2	3	3	5	3	7	4					
Veg										2	2		1	1					1				1			1		1	1							
Misc													1	2	2	4	1	1	2		1	2	2	5	4	8	6	7	7	11	8					

Morbidity history	
Diarrhea	●
Cough	●
Fever	▲



# Shrabonti: Length/Height for age z score

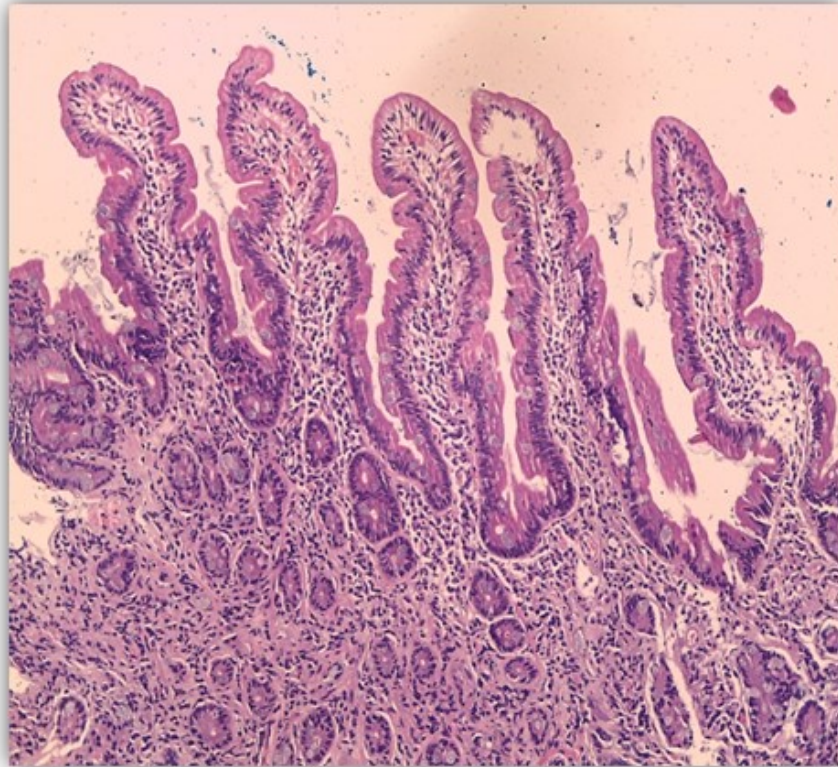


- Exclusively breastfed for more than 5 mo
- 46 episodes of illnesses over 2 ½ years
- Sparse animal source food in diet

Major Food Group	0-6	7-12	13-18	19-24	25-30	31-36	37-42	43-48	49-54	55-60	61-66	67-72	73-78	79-84	85-90	91-96	97-102	103-108	109-114	115-120					
Condiment																									
Breast milk																									
Fruit																									
Legume																									
Beef																									
Chicken																									
Fish																									
Egg																									
Starch																									
Veg				2	2	1	1																		
Misc						1	2	2	4	1	1	2			1	2	2	5	4	8	6	7	7	11	8

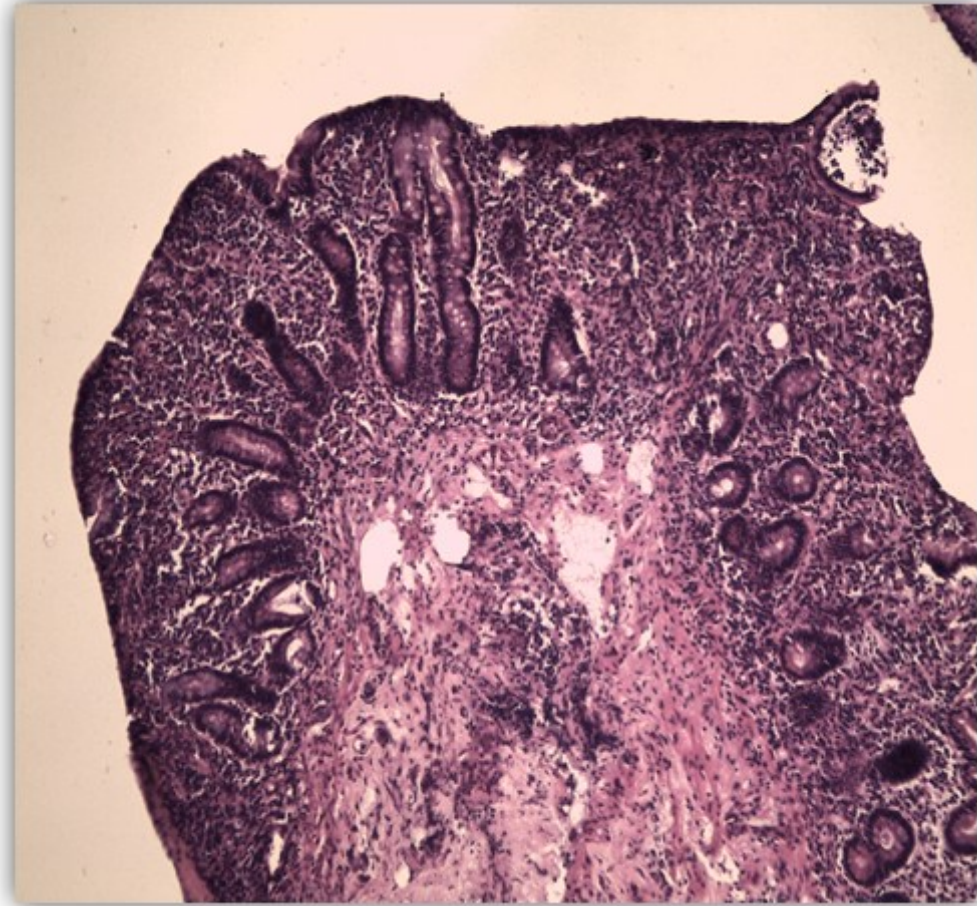
Morbidity history	
Diarrhea	●
Cough	●
Fever	▲

Normal intestinal villi



Healthy

Total villous atrophy



Environmental Enteropathy

# What are the solutions?

- Population control
- WASH
- Food security
- Agriculture based innovative solutions





# **Daily Supplementation With Egg, Cow Milk, and Multiple Micronutrients Increases Linear Growth of Young Children with Short Stature**

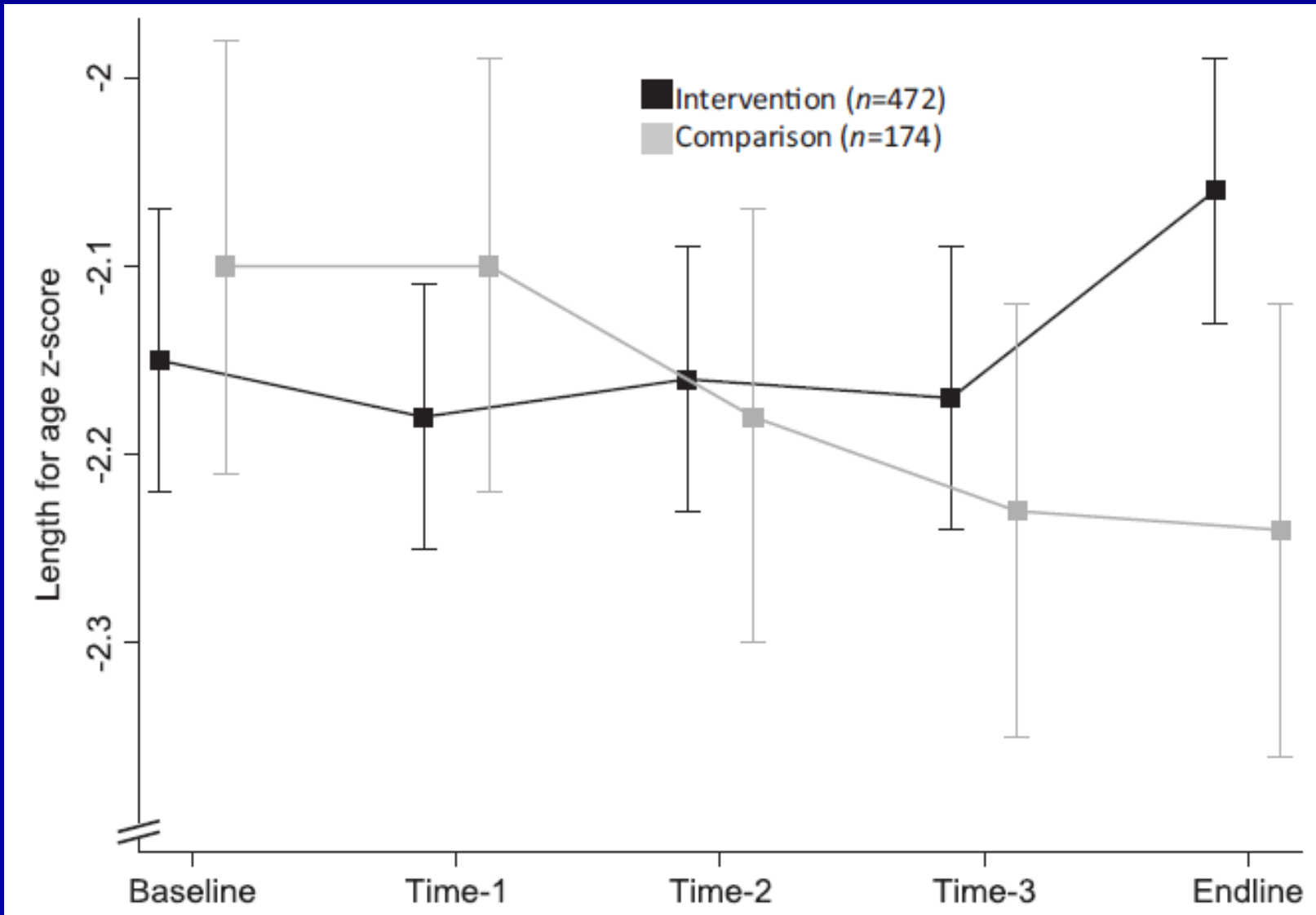
Mahfuz M, Alam A, Das S, Fahim SM, Hossain MS, Petri WA, Ashorn P, Ashorn U, Ahmed T



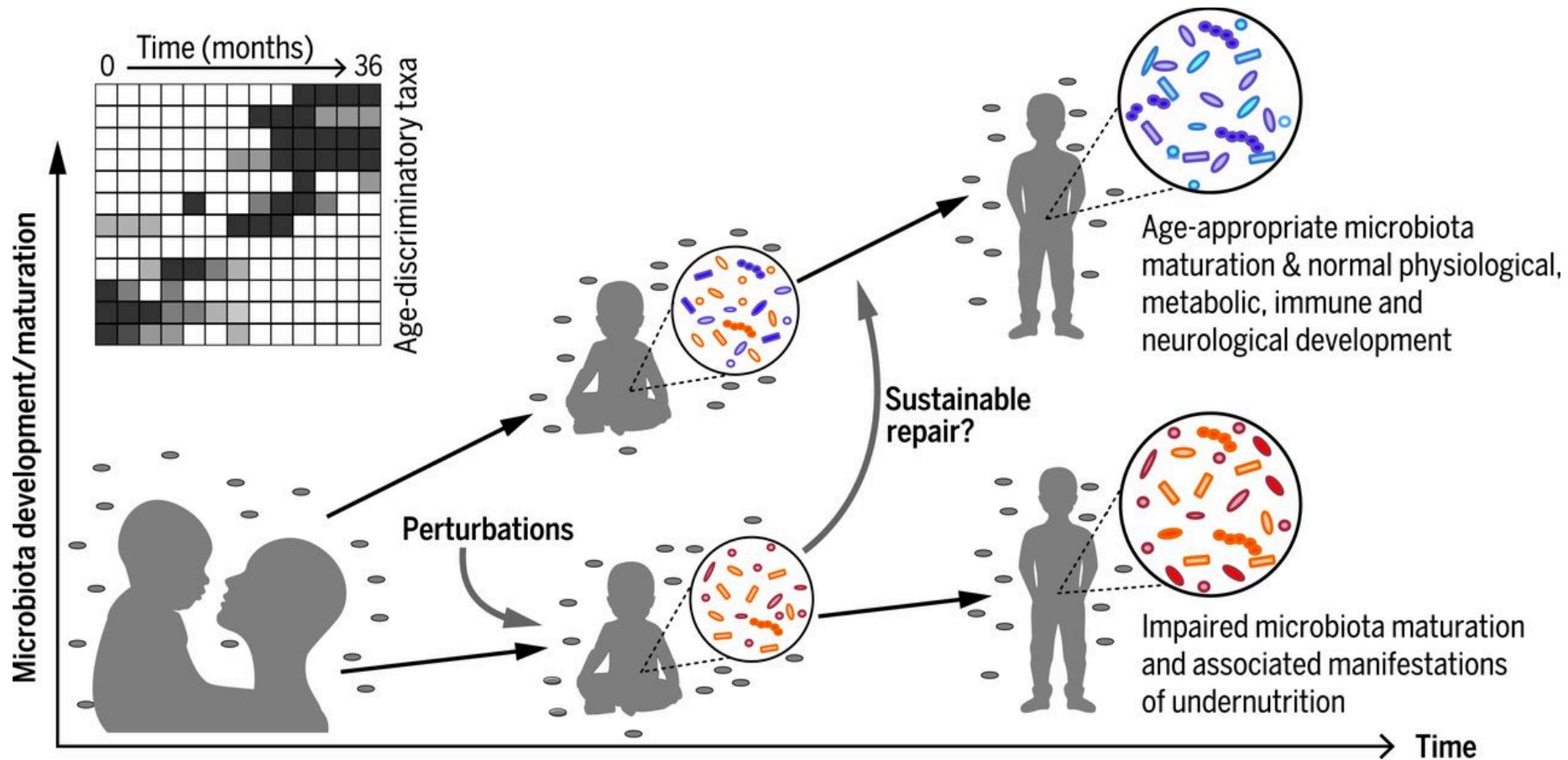


# Egg, milk and micronutrient supplementation: Impact on linear growth

	n	Intervention	n	Comparison	DID	p
Baseline	472	-2.15 (-2.22, -2.07)	174	-2.10 (-2.21, -1.98)	0.23 (0.18, 0.29)	<0.001
Endline	472	-2.06 (-2.13, -1.99)	174	-2.24 (-2.36, -2.12)		



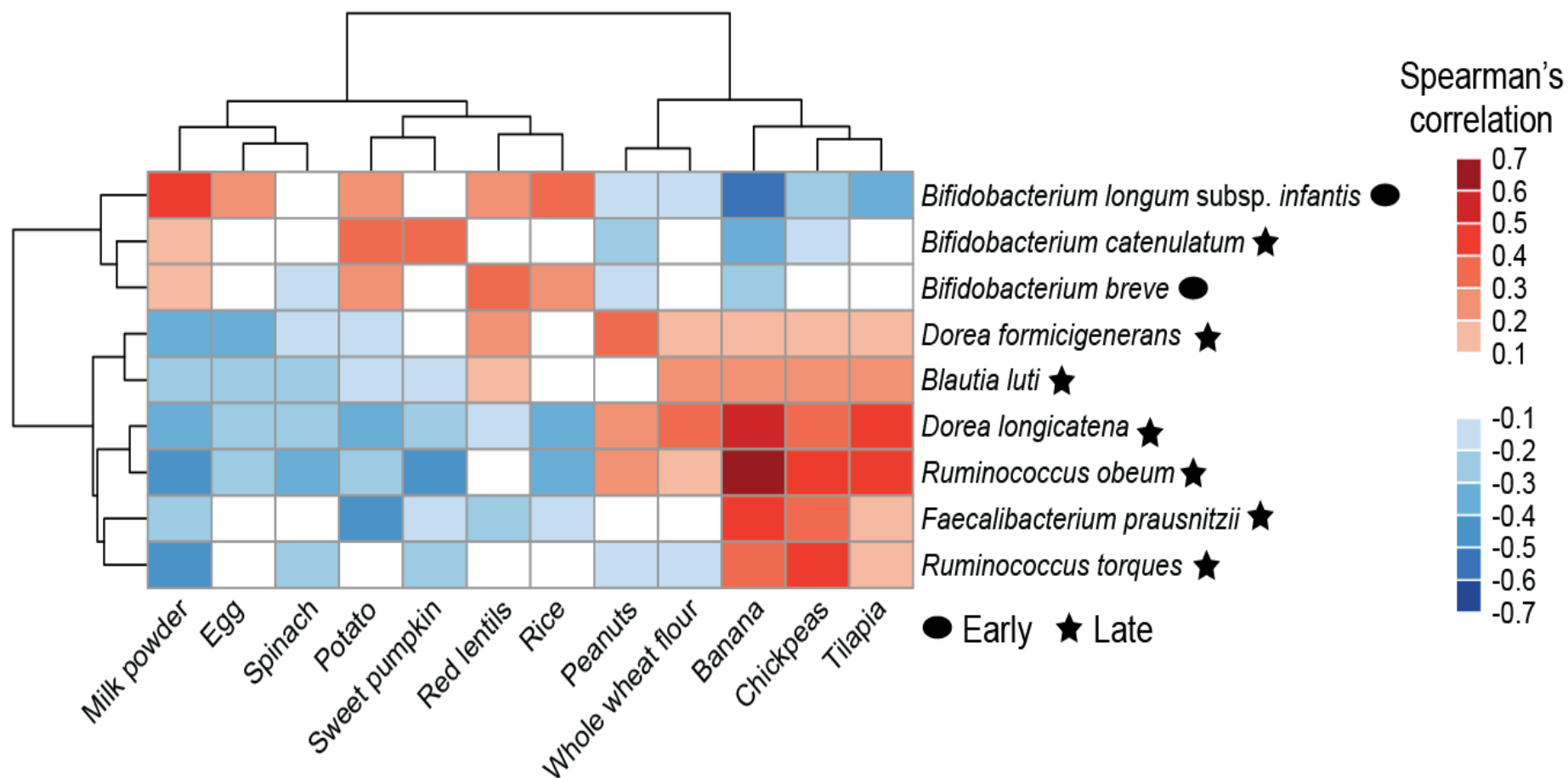
# Impaired postnatal gut microbiota development (maturation) is causally related to childhood undernutrition



# Modulating the gut microbiota to improve growth in children

- Our previous research shows presence of good and bad bacteria in the intestine of children
- How do we increase the numbers of good, growth promoting bacteria in the intestine?
- One way is giving them the good bacteria
- We thought that the correct way would be to promote their numbers by giving them an appropriate diet

# Relative abundance of 'good' microbiota and association with local food ingredients







Science 315  
12 JULY 2010  
science.org AAAS

ARTIFICIAL  
MUSCLES

Heating prestretched  
fibers triggers contraction  
pp. 125, 145, 192 & 155



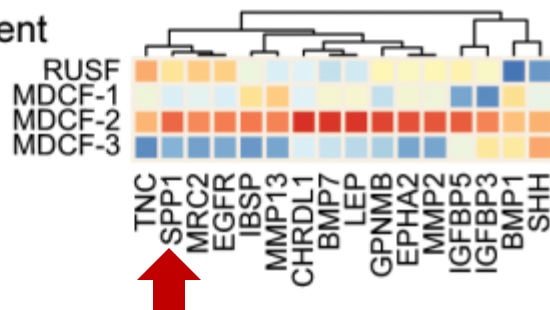
12 July 2019

# Effects of microbiota-directed foods in gnotobiotic animals and undernourished children

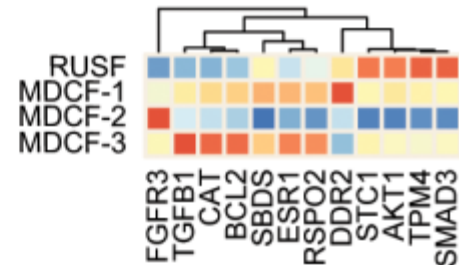
Jeanette L. Gehrig<sup>1,2\*</sup>, Siddarth Venkatesh<sup>1,2\*</sup>, Hao-Wei Chang<sup>1,2\*</sup>,  
Matthew C. Hibberd<sup>1,2</sup>, Vanderlene L. Kung<sup>1,2,3</sup>, Jiye Cheng<sup>1,2</sup>, Robert Y. Chen<sup>1,2</sup>,  
Sathish Subramanian<sup>1,2†</sup>, Carrie A. Cowardin<sup>1,2</sup>, Martin F. Meier<sup>1,2</sup>, David O'Donnell<sup>1,2</sup>,  
Michael Talcott<sup>4</sup>, Larry D. Spears<sup>5</sup>, Clay F. Semenkovich<sup>5</sup>, Bernard Henrissat<sup>6,7</sup>,  
Richard J. Giannone<sup>8</sup>, Robert L. Hettich<sup>8</sup>, Olga Ilkayeva<sup>9,10</sup>, Michael Muehlbauer<sup>9,10</sup>,  
Christopher B. Newgard<sup>9,10,11,12</sup>, Christopher Sawyer<sup>13,14</sup>, Richard D. Head<sup>13,14</sup>,  
Dmitry A. Rodionov<sup>15,16</sup>, Aleksandr A. Arzamasov<sup>15,16</sup>, Semen A. Leyn<sup>15,16</sup>,  
Andrei L. Osterman<sup>16</sup>, Md Iqbal Hossain<sup>17</sup>, Munirul Islam<sup>17</sup>, Nuzhat Choudhury<sup>17</sup>,  
Shafiqul Alam Sarker<sup>17</sup>, Sayeeda Huq<sup>17</sup>, Imteaz Mahmud<sup>17</sup>, Ishita Mostafa<sup>17</sup>,  
Mustafa Mahfuz<sup>17</sup>, Michael J. Barratt<sup>1,2</sup>, Tahmeed Ahmed<sup>17</sup>, Jeffrey I. Gordon<sup>1,2†</sup>

## A Bone development

Healthy growth  
discriminatory

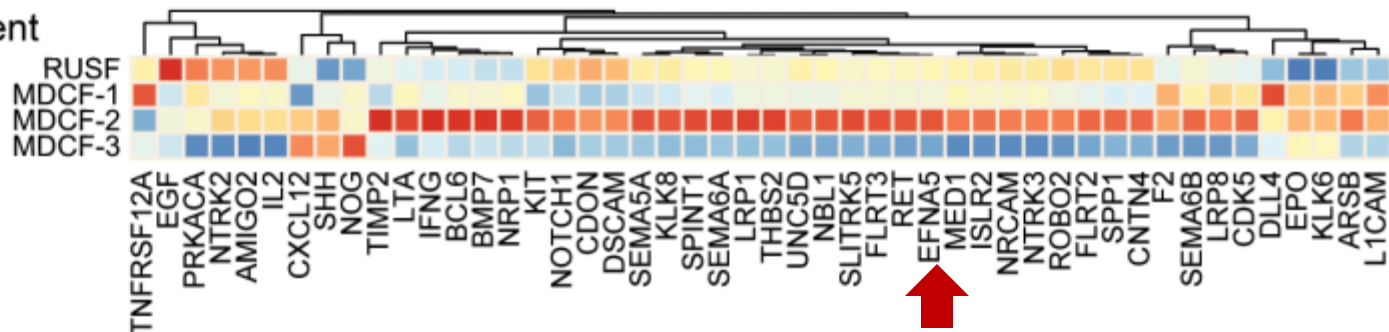


SAM  
discriminatory

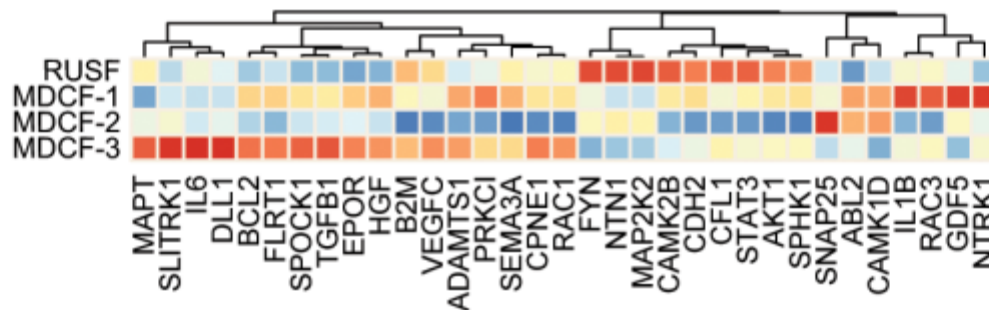


## B CNS development

Healthy growth  
discriminatory

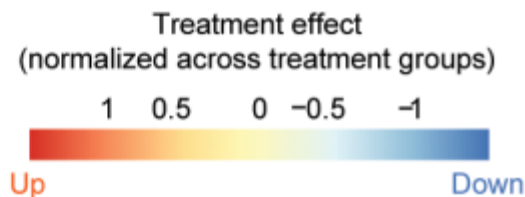
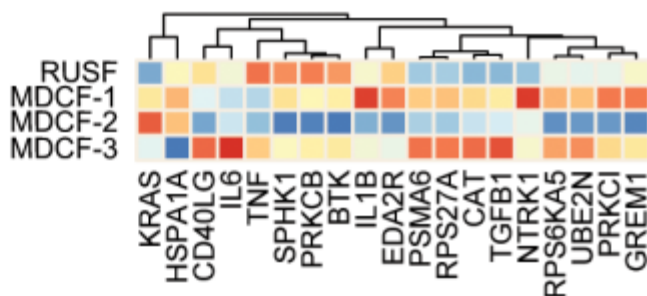


SAM  
discriminatory



## C NF- $\kappa$ B signaling

SAM  
discriminatory





8 nutrition centers in Mirpur slum  
On site feeding of MDCF



# Conclusion

- Stunting and EED are diseases of poverty, the solutions have to be political at the national level and equitable at the global level
- But interim solutions are required, few have been tested for stunting, even fewer for environmental enteropathy
- Agriculture based interventions are key to solving the malnutrition problem
- Interventions based on modulation of the gut microbiota by using food based recipes appear to be promising