

Childhood Undernutrition: a biological perspective



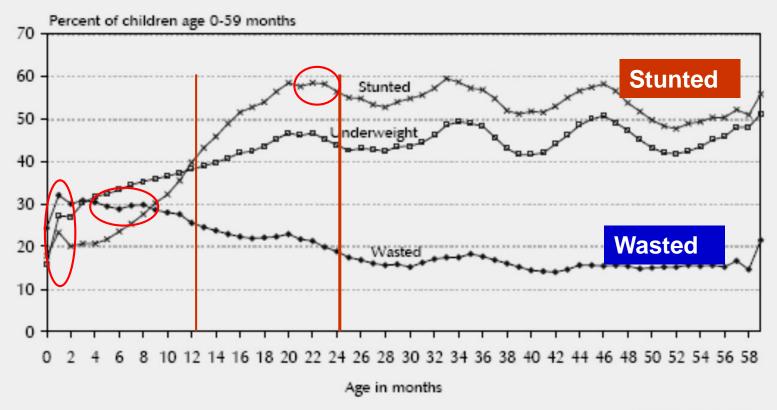


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Undernutrition trend by age



NFHS-3, India, 2005-06

Undernutrition is substantial at birth, peaks by 2 years

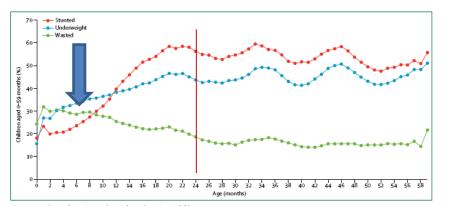
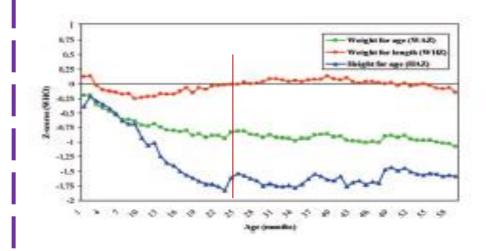


Figure 4: Prevalence of stunting, underweight, and wasting in children (age <5 years) Reproduced with permission from International Institute for Population Sciences.¹

INDIA

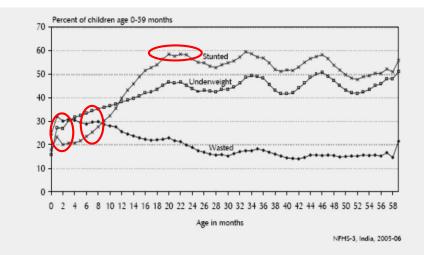
WORLD



Victora 2009

Undernutrition trend by age tells a great deal

- 1. 30% are stunted and 25% are wasted at ~1month
 - Not surprising, as one third neonates are low birth weight
 - Maternal factors therefore must be very important
- Wasting incidence peaks at 3-12 months
- 3. Stunting incidence peaks between 18 mo to 24 months



✓ Act before birth with mother

✓ Act from 1st hour, 1st day of life, through 1st year ...

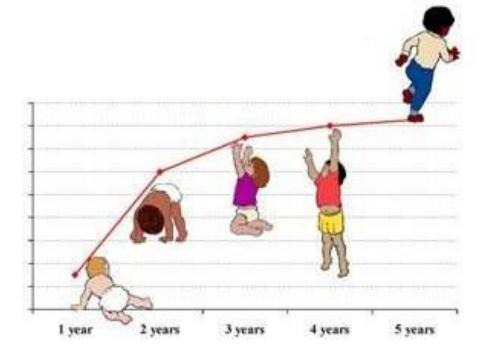
✓ Too late after 24 months

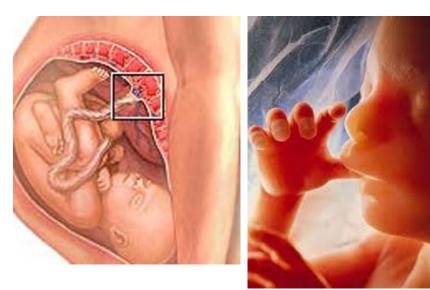
Childhood undernutrition has three parents

- 1. Poor fetal growth / LBW
- 2. Illness (Diarrhea)
- 3. Sub-optimal nutrition

Poor fetal growth / low birth weight

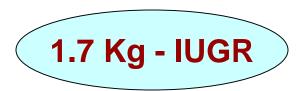
A lot happens before birth



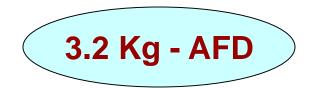




~20% babies have fetal growth restriction

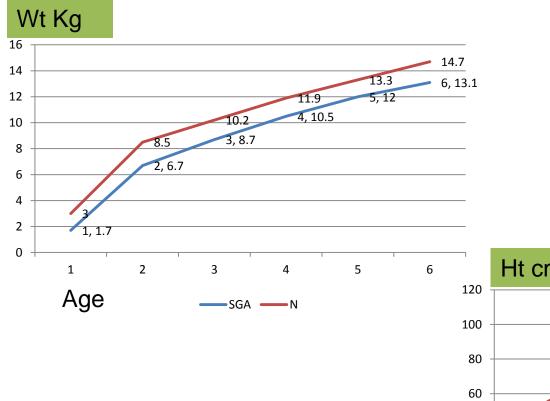




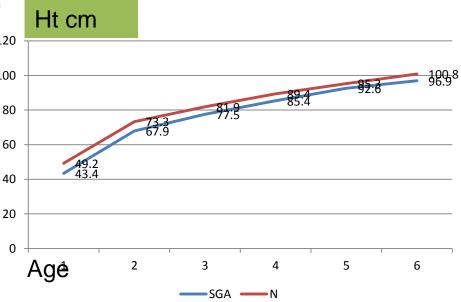




Babies born small / undernourished at birth, grow poorly later in life



Bhargava 1984



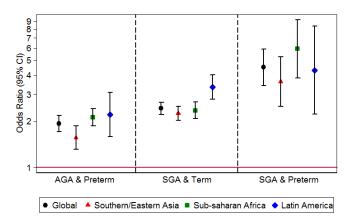
Small size at birth determines childhood undernutrition

~20% Stunting and ~30% wasting is contributed to by small size at birth

Risk of childhood undernutrition related to small-for-gestational age and preterm birth in low- and middle-income countries

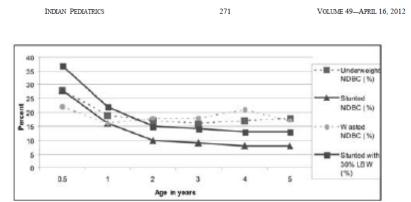
Int J Epidemiol. 2013 October ; 42(5):

Chrisian 2013



Overcoming Challenges to Accelerating Linear Growth in Indian Children

HPS SACHDEV



Maternal determinants of LBW

- 1. Maternal age
- 2. Education
- 3. Antenatal Care

4. Body Mass Index

Characteristic	Prevalence %	LBW (4243 infants with low birth weight)		
		Adjusted OR (95% CI)	PAR (%)	
For all birth orders				
Maternal age at child birth (yrs)				
≥ 20	88.3	1.00	9.1%	
< 20	21.7	1.46 (1.28 1.67)		
Literacy				
Literate	50.0	1.00	12.3%	
Illiterate	50.0	1.28 (1.12 1.46)		
Residence				
Urban	56.8	1.00	8.3%	
Rural	43.2	1.21 (1.05 1.39)		
Gender				
Male	53.3	1.00	8.9%	
Female	46.7	1.21 (1.09 1.35)		
ANC visits				
At least one visit	77.1	1.00	13.8%	
Nil	22.9	1.70 (1.31, 2.20)		

Paul. Lancet 2011

Understanding Child Stunting in India: A Comprehensive Analysis of Socio-Economic, Nutritional and Environmental Determinants Using Additive Quantile Regression

Nora Fenske¹*, Jacob Burns², Torsten Hothorn¹, Eva A. Rehfuess² PLOS 2013

Analysis of NFHS 3 data

Food supplementation to mothers

 Maternal energy supplementation leads to about 72g in birth weight, it lowers incidence of LBW 32%

100g	in	poorly
nouri	sh	ed

	Expe	rimenta	l i	C	ontrol			Mean Difference	Mean Difference
tudy or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
.4.1 Malnourished women									
ltton 1990 ²⁹	3130	374	87	3190	402	61	5.0%	-60.00 [-187.88, 67.88]	
Backwell 1973 ³¹	3082.13	400	55	2941.93	306	55	4.8%	140.20 [7.10, 273.30]	
Campbell Brown 1983 ³⁶	3032	372	90	2995	395	90	5.6%	37.00 [-75.10, 149.10]	
Ceesay 1997 ³⁵	2966	422	620	2860	427	553	8.0%	106.00 [57.32, 154.68]	
Girija 1984 ³⁴	2939	376	10	2676	451	10	1.2%	263.00 [-100.93, 626.93]	
luybregts 2009 ⁴⁰	2916	408	64	2810	480	54	3.9%	106.00 [-56.42, 268.42]	
Mardones-Santander 198823	3178	483	391	2990.7	340.2	38	5.3%	187.30 [69.01, 305.59]	
Netcoff 1985 ³⁹	3234	90	238	3059	90	172	8.7%	175.00 [157.35, 192.65]	v
/ora 1978 ³²	2978	377	207	2927	392	200	7.0%	51.00 [-23.76, 125.76]	+
Prentice 198738	2997	378.9	197	2880	119.6	182	7.7%	117.00 [61.31, 172.69]	
Rush 1980 ²⁵	3011	508	256	2970	535	264	6.4%	41.00 [-48.65, 130.65]	
/iegas 1982 ²¹	3184	540	31	3027	255	14	2.5%	157.00 [-75.33, 389.33]	
Subtotal (95% CI)			2246			1693	66.2%	100.86 [56.14, 145.58]	•
leterogeneity: Tau ² = 3318.2 Test for overall effect: Z = 4.4	2 (P < 0.00	0001)							
		0001)							
est for overall effect: Z = 4.4		335		3189.93	333	56	5.2%	-5.93 [-129.10, 117.24]	
est for overall effect: Z = 4.4	l women			3189.93 3325	333 498	56 562	5.2% 7.6%	-5.93 [-129.10, 117.24] 53.00 [-5.70, 111.70]	
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est for overall effect: Z = 4.4 .4.2 Adequately Nourished Nackwell 1973 ³¹ Ewood 1981 ³³	1 women 3184 3378	335 519	57 591	3325	498	562	7.6%	53.00 [-5.70, 111.70]	
est for overall effect: Z = 4.4 .4.2 Adequately Nourished Nackwell 1973 ³¹ Ewood 1981 ³³ Huybregts 2009 ⁴⁰	I women 3184 3378 2945	335 519 463	57 591 457	3325 2947	498 425	562 439	7.6% 7.6%	53.00 [-5.70, 111.70] -2.00 [-60.16, 56.16]	
iest for overall effect: Z = 4.4 .4.2 Adequately Nourished Nackwell 1973 ³¹ Elwood 1981 ³³ Ruybregts 2009 ⁴⁰ Caseb 2002 ³⁷	1 women 3184 3378 2945 3300	335 519 463 400	57 591 457 28	3325 2947 3080	498 425 310	562 439 25	7.6% 7.6% 3.2%	53.00 [-5.70, 111.70] -2.00 [-60.16, 56.16] 220.00 [28.38, 411.62]	
est for overall effect: Z = 4.4 .4.2 Adequately Nourished Nackwell 1973 ³¹ Swood 1981 ³³ Nuybregts 2009 ⁴⁰ Caseb 2002 ⁵⁷ Ross 1985 ³⁰	3184 3378 2945 3300 3229	335 519 463 400 432	57 591 457 28 62	3325 2947 3080 3171	498 425 310 483	562 439 25 33	7.6% 7.6% 3.2% 3.1%	53.00 [-5.70, 111.70] -2.00 [-60.16, 56.16] 220.00 [28.38, 411.62] 58.00 [-138.77, 254.77]	
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Figure 2. Effect of balanced protein-energy supplementation on birthweight (g).

Maternal Interventions

ICDS

 Food supplementation

Health

• Antenatal care

Both + others

- No teenage pregnancy
- Adolescent nutrition

Diarrhea and other infections

Diarrhea contributes to ~25% of undernutrition; other infections also add risk

Proportion of stunting attributed to 5 or more episodes of diarrhea before 2 years was 25%. Chekley 2008

Other infections; Pneumonia Measles

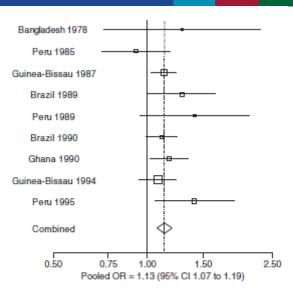


Figure 3 Effect of diarrhoeal incidence prior to 24 months on stunting at 24 months of age. Point estimates of the effect of diarrhoeal incidence on stunting at 24 months are shown for each study. The size of the square around the point estimate is proportional to sample size. The lines represent 95% CI. In the pooled estimate, represented by a diamond, the odds of stunting at 24 months increased by 1.13 when diarrhoeal incidence prior to 24 months increased by five episodes (95% CI 1.07 to 1.19)

What works for diarrhea (and other infections)

Health (and ICDS)

- Prevention
 - Breastfeeding
 - Measles vaccine
 - Hand washing
- Treatment
 - ORS
 - Continued feeding in sickness
 - Zinc
 - Antibiotics

Other sectors, people

 Water and sanitation

Everything in the program. Coverage is the issue!

Sub-optimal feeding

Sub optimal feeding

- Lack of knowledge
- Food insufficiency
- Lack of time
- Lack of skills
- Lack of support
- Taboos

Infant and young child feeding

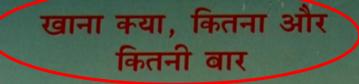
0-6 mo

- Breastfeeding
 - Early
 - Exclusive
- Supporting small babies
 - Assisted feeding
 - Kangaroo mother Care

Feeding low birth weight babies

- Need extra care in feeding
- Fed expressed breast milk
- HWs need additional skills





6 महीने से 1 साल





1 कटोरी आहार दिन में 3 बार

1 से 2 साल



11/2 कटोरी आहार दिन में 5 बार



बहला कर खिलाने के तरीके

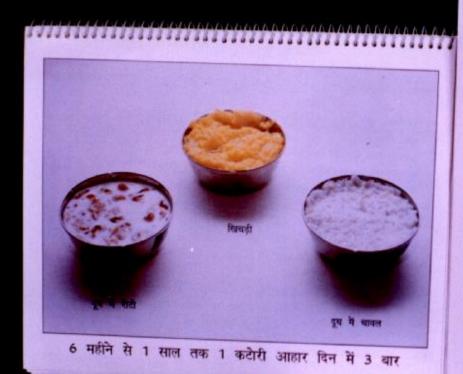






माँ लाड़ से खिलाए आहार एक दिन में बार-बार

Energy density



-	6 मतीने से सोटे	6 मानि ने 1 माल	1 से 2 साल
स्तनपान	जन्म के तुरुत बाद भुश करें, 24 पीटे में कम से कम 8 बार जरूर पिलाएं केवल मी का दूम दे	जारी रखे	वारी रहे
कपरी आसार बहाना देना		6 माठिने पर नीचे दिए तए बाहार में से ½ कटोरी जातार दिन में 3 कार दें(मी में दुध के साथ साथ) वा 5 बार दें (परि बच्चा मों का दूप न पीता से)। धीरे-धीरे माजा बहाकर 9 माठिने की जातु तक 1 कटोरी आसार कर दे।	
		बन्धे को गोंद में बैठाकर जपने हाथ से साना दिल्ला[वच्चे के पास बैठकर पूरा साना साने और सल्म करने में मदद करें
	10 - 10 - C. S.	हर बार साना वित्ताने से पाले अपने और बच्चे के हाय सामुन से ज़रुर कोएं	हर बार साना विस्ताने हे पाले अपने और बच्चे के
तमार त्वा	स्तनचन करते रहे	पाले की तरह ही सही भाषा	गांध सामुल से जगर धोएँ फाते की तरह ही सही भाजा में हभी साना सिलाते रहे

आहार सम्बन्धित सुझाव की सूची

तर्जी के लिए -

चीनी साने किना चानी सिते दूध में मसली हुई रोटी या भावल या बैड या किन्कुट जिला कर है
 ची या तेल जिली साडी दाल में मसली हुई रोटी या भावत या बैड जिलाकर दे या ची या तेल जिली किन्द्रती

- दूध में बनी सेवियों या प्रतिया या सतवा था सीर या दूध से बनी यूसरी कीये है
- उनने या ताने हुए आपू या विना मिर्च वाली आपू भी नवती मसलकर हे
- केल स बिस्कुट या चीक् स अब सा परीस बीच बीच में दे
- 1 से 2 सात के बच्चों को घर में बना सब साना सिलाएँ





Infant and young child feeding

0-6 mo

- Breastfeeding
 - Early
 - Exclusive
- Supporting small babies
 - Assisted feeding
 - Kangaroo mother Care

After 6 mo

- Continued breast feeding
- Complementary feeding
 - Starting at right time
 - Approriate
 - Enough
 - Offered with love

Detection and management of moderate and severe acute malnutrition



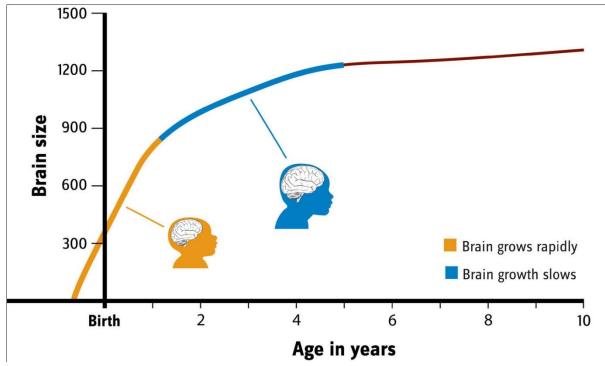
Feeding during the first two years: who is responsible?

1 st mo	Breastfeeding	ASHA
	Supporting small baby	ASHA
1 mo +	Complementary feeding support	??
	Moderate Malnutrition <2yr	?ICDS
	Severe malnutrition	Health + ICDS

Why first 2 years of life are the window



Brain develops by 2 years



- At birth, the human brain weighs approximately 350 grams.
- By the first year, the brain weighs approximately 1000 grams.
- The adult brain weighs 1200-1400 grams.
- No significant increase in number of neurons after birth
- Main event postnatally: synaptogenesis (>80%) through 2nd year of life

Why first 2 years of life are the window

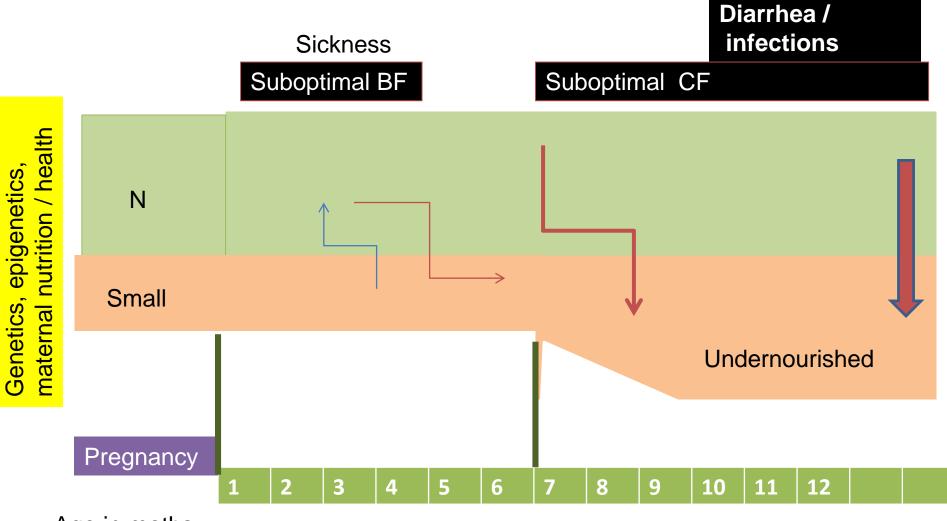
- Undernutrition occurs in the first and the second year
- Period of rapid brain growth and maturation
- Linear growth failure in this period is associated with adult short stature
 - Low productivity
 - Less schooling
 - Lower offspring birthweight (females)

What is modifiable? By whom? Red = Health; Blue ICDS, Green = both

Modifiable fast	Modifiable slowly	Not modifiable				
Maternal factors / IUGR						
ANC	Delayed age at childbirth	Intergenerational effects				
Energy supplementation	Adolescent nutrition					
	Poverty, illiteracy					
Newborn & child						
Breast feeding	Complementary feeding					
LBW feeding	Sanitation					
Treating diarrhea with Zn, ORS, feeding; pneumonia with ab						
Managing SAM						
Immunization						

Stunting is slow to change, wasting is somewhat more amenable

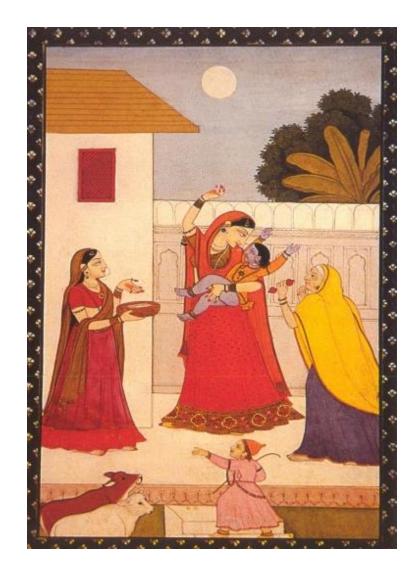
'Biology' of undernutrition



Age in moths

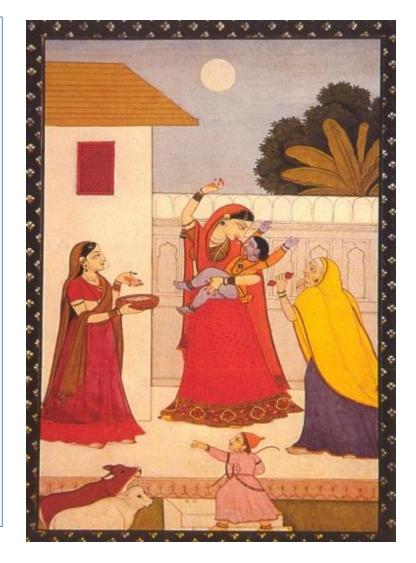
Key points

- Almost of half of childhood undernutrition is about fetal growth and infections, and not food per se
- Accelerating priority action for <2's is to universalize:
 - Home Based Care of Newborns
 - Zn in diarrhea
 - Management of SAM
 - CF, CF, CF



Key points

- Think of the
 <2's
- Coverage with quality is the key





"Knowing is not enough, we must apply;

Willing is not enough, we must <u>do</u>."

Goethe



