



Childhood Undernutrition: a biological perspective



Vinod Paul

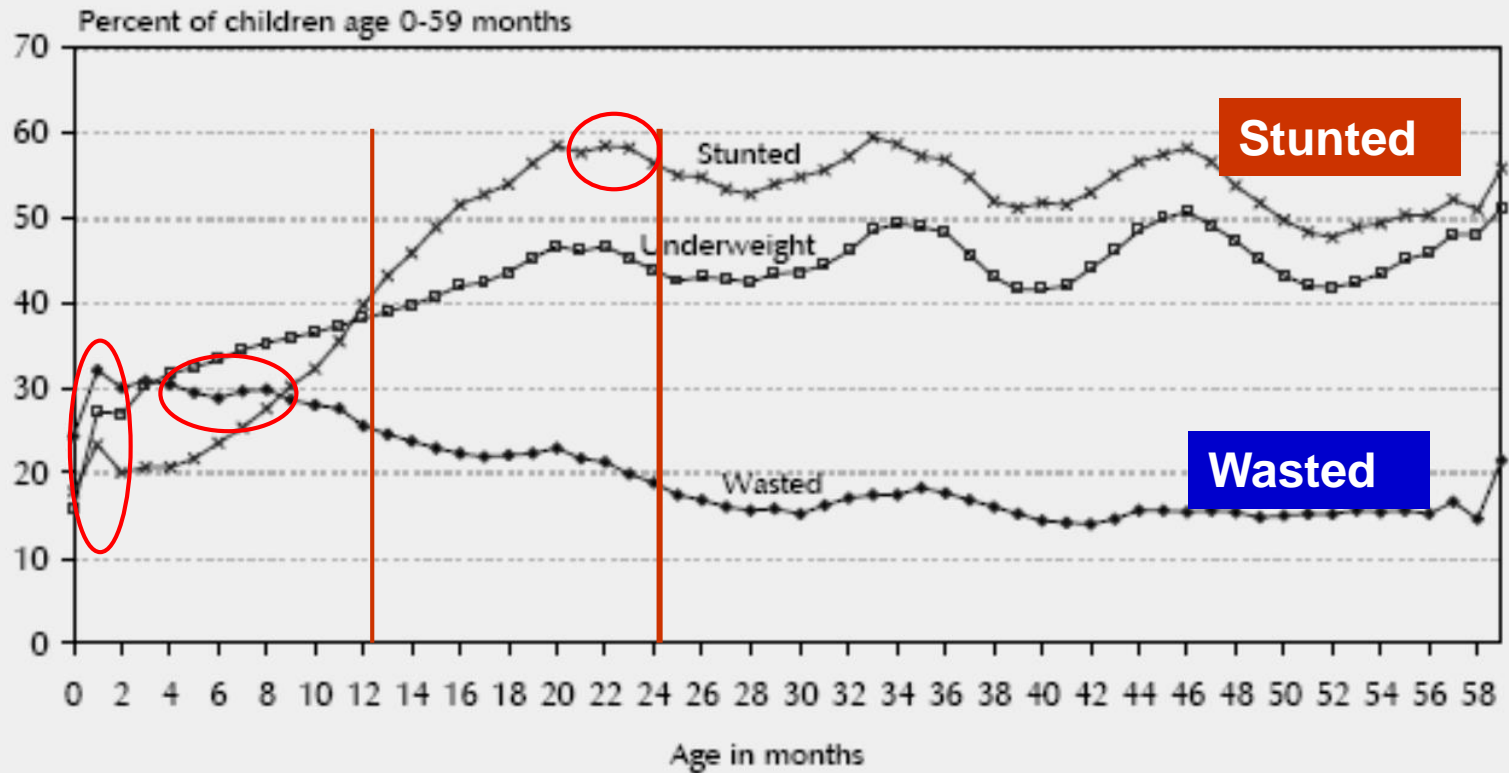
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Undernutrition trend by age



Undernutrition is substantial at birth, peaks by 2 years

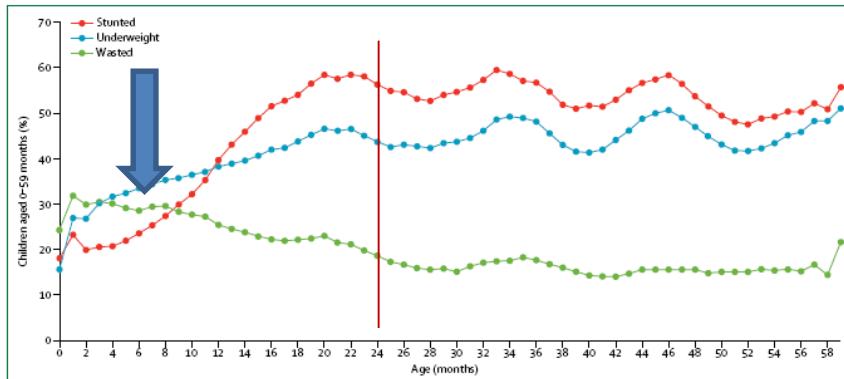
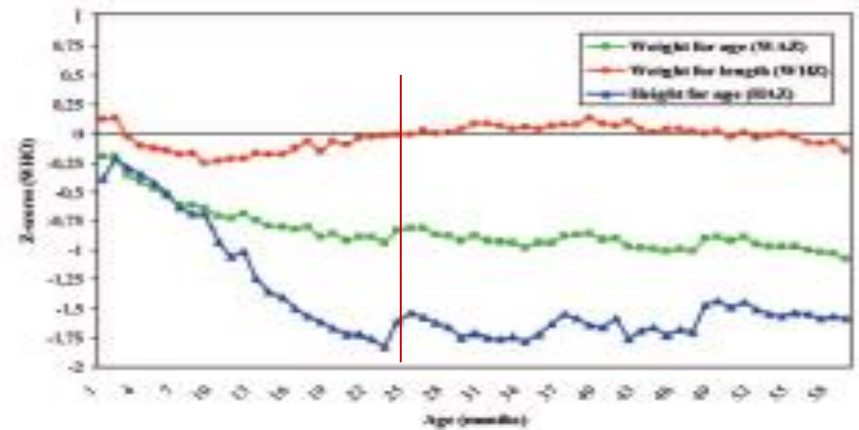


Figure 4: Prevalence of stunting, underweight, and wasting in children (age <5 years)
Reproduced with permission from International Institute for Population Sciences.

INDIA

WORLD



Victoria 2009

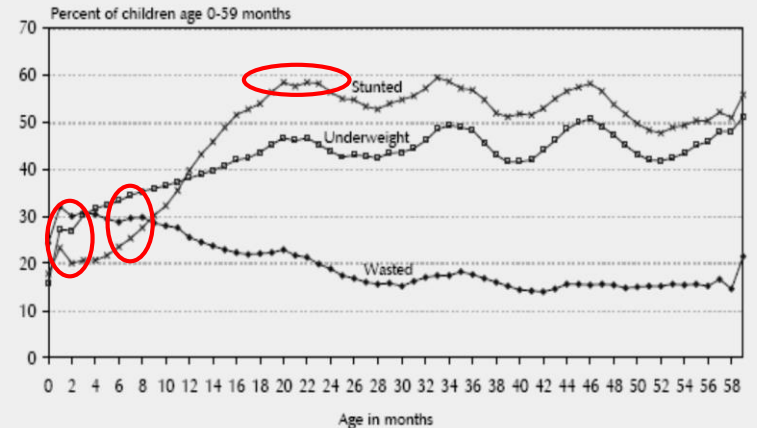
Undernutrition trend by age tells a great deal

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

2. 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 ...

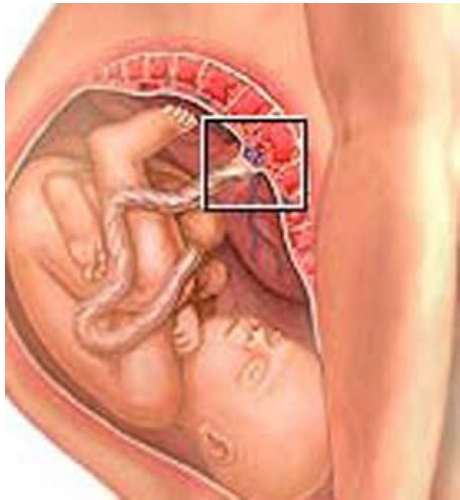
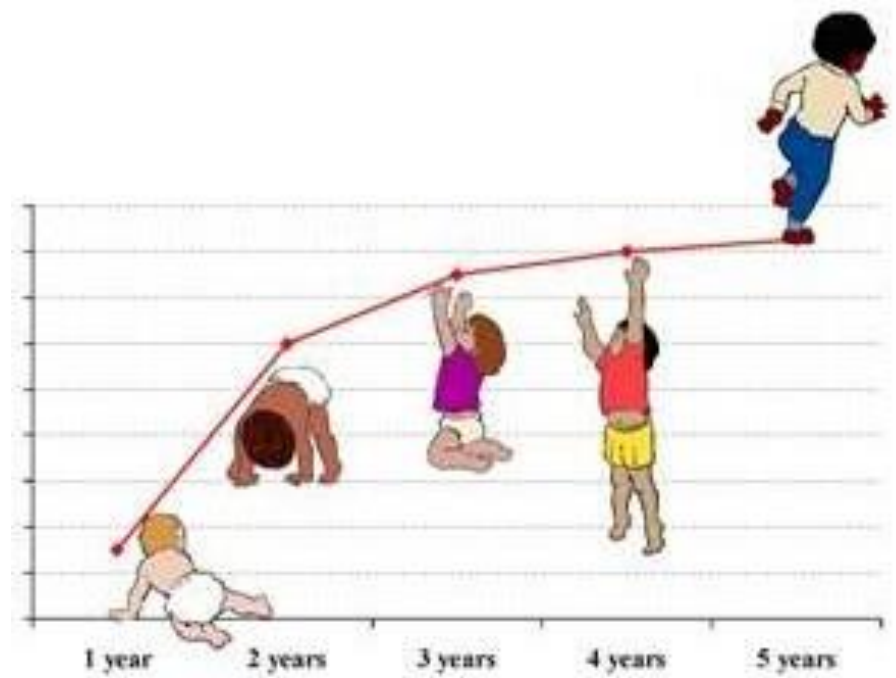
✓ Too late after 24 months

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

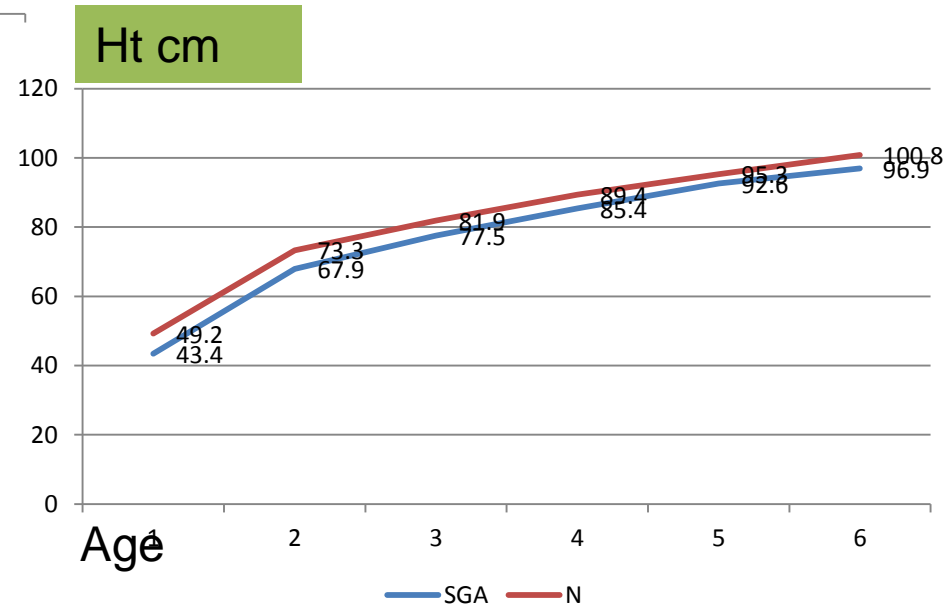
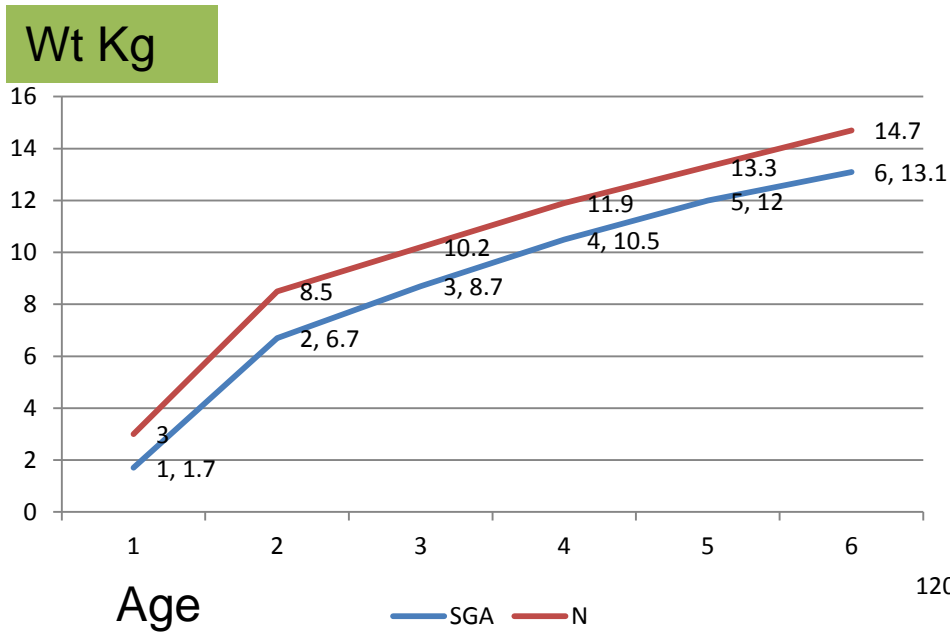
1.7 Kg - IUGR



3.2 Kg - AFD



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



Bhargava
1984

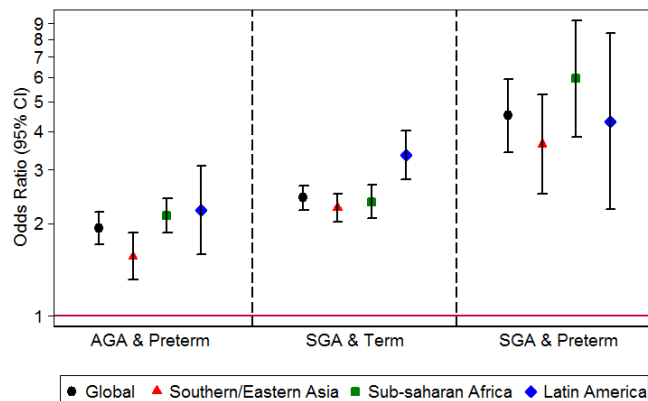
Small size at birth determines childhood undernutrition

~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



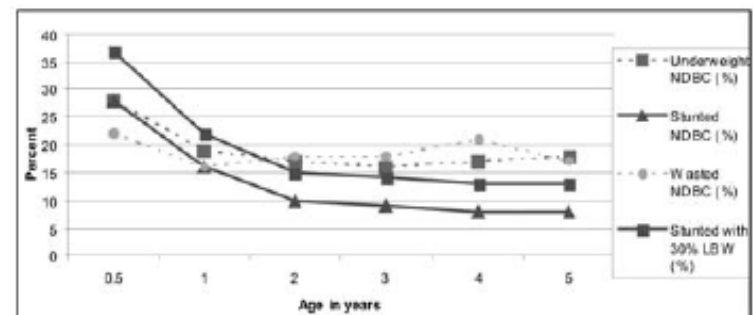
Overcoming Challenges to Accelerating Linear Growth in Indian Children

HPS SACHDEV

INDIAN PEDIATRICS

271

VOLUME 49—APRIL 16, 2012



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 Fenske^{1*}, 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%

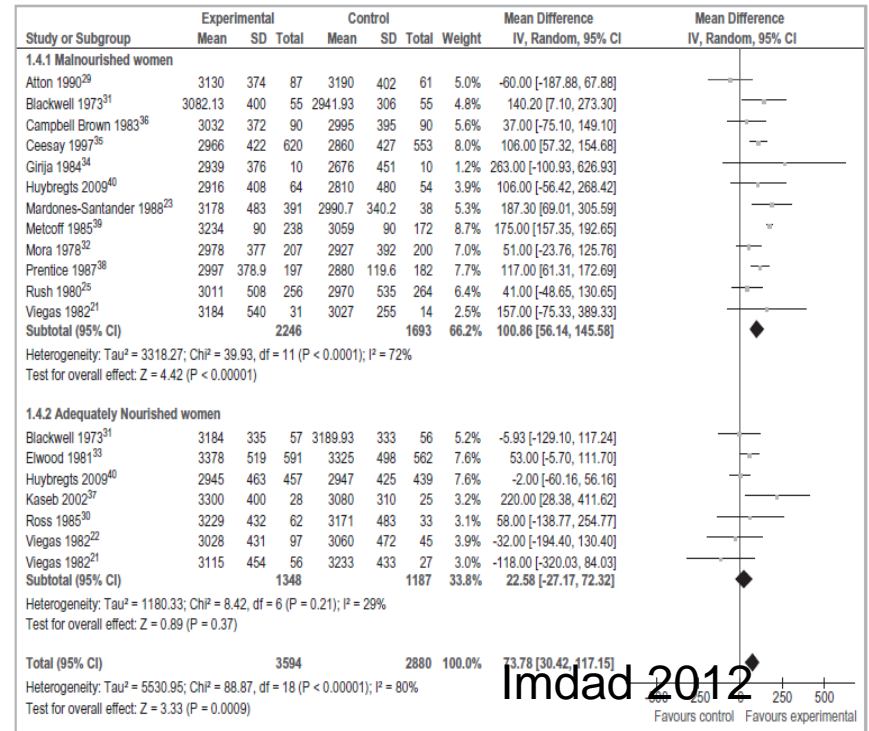


Figure 2. Effect of balanced protein-energy supplementation on birthweight (g).

100g in poorly
nourished

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

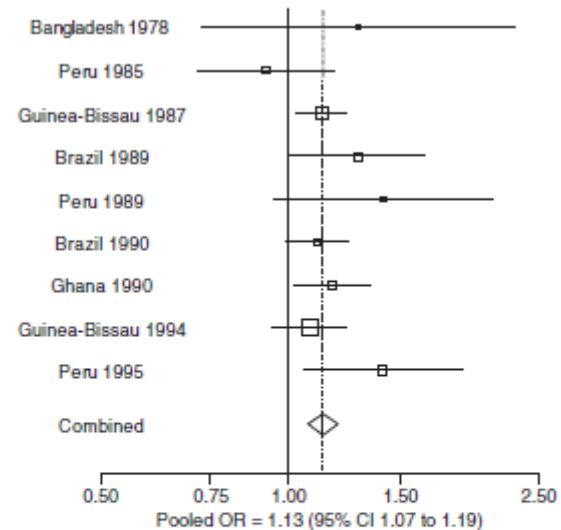


Figure 3 Effect of diarrhoeal incidence prior to 24 months on stunting at 24 months of age. Point estimates of the effect of diarrhoeal incidence on stunting at 24 months are shown for each study. The size of the square around the point estimate is proportional to sample size. The lines represent 95% 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

Give oral feeds
by cup/spoon/
paladai



खाना क्या, कितना और कितनी बार

6 महीने से 1 साल



1 कटोरी आहार दिन में 3 बार

1 से 2 साल



1½ कटोरी आहार दिन में 5 बार

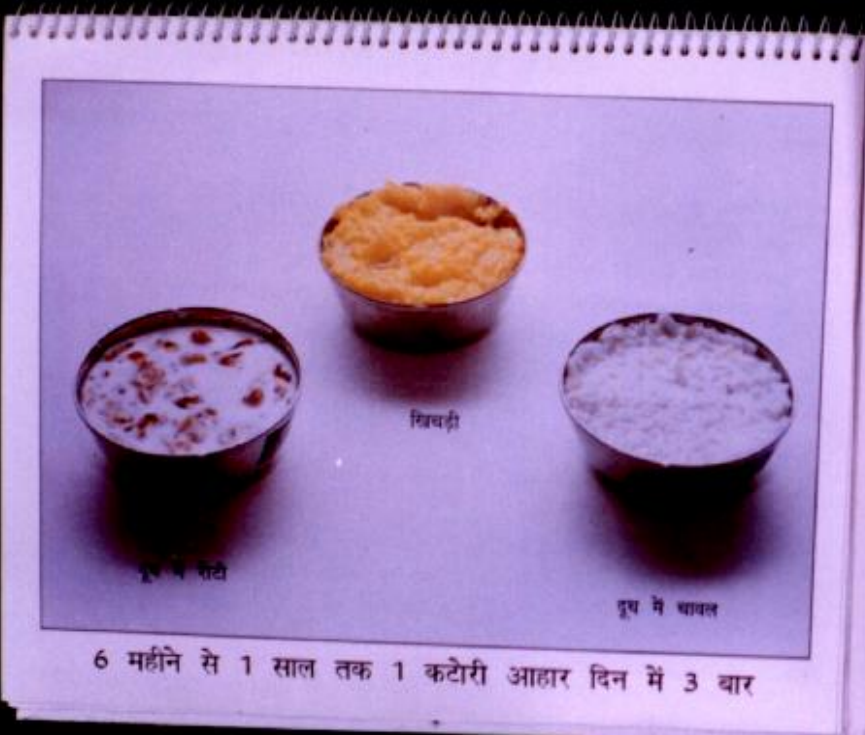


बहला कर खिलाने के तरीके



माँ लाड़ से खिलाए आहार
एक दिन में बार-बार

Energy density



बच्चों के लिए आहार सम्बन्धित मुद्दाव की रूपरेखा कार्य सहायक पत्रिका

	6 महीने से छोटे	6 महीने से 1 साल	1 से 2 साल
स्तनपान	जन्म के तुरन्त बाद शुरू करें, 24 घंटे में कम से कम 8 बार लक्षर मिलाने केवल माँ का दूध दें	जारी रखें	जारी रखें
ऊपरी आहार		6 महीने पर नीचे दिए गए आहार में से 1/2 कटोरी आहार दिन में 3 बार दें (माँ के दूध के साथ साथ) या 5 बार दें (यदि बच्चा माँ का दूध न पीता हो)। धीरे-धीरे मात्रा बढ़ाकर 9 महीने की आयु तक 1 कटोरी आहार कर दें।	नीचे दिए गए आहार में से 1 1/2 कटोरी आहार दिन में 5 बार दें
बाह्य देना		बच्चे को रोध में बैठकर अपने हाथ से खाना मिलाने	बच्चे के पास बैठकर पूरा खाना खाने और साथ करने में मदद करें
सम्बद्धता		हर बार खाना मिलाने से पहले अपने और बच्चे के हाथ साबुन से लक्षर धोएं	हर बार खाना मिलाने से पहले अपने और बच्चे के हाथ साबुन से लक्षर धोएं
दीवार बच्चा	स्तनपान करते रहें	पहले की तरह ही सही मात्रा में सभी खाना मिलाने रहें	पहले की तरह ही सही मात्रा में सभी खाना मिलाने रहें

आहार सम्बन्धित मुद्दाव की सूची

- पीनी वाले बिना पानी मिले दूध में मसाली हुई रोटी या चावल या बैट व किचुट मिला कर दें
- सी या तेल मिली सजी दाल में मसाली हुई रोटी या चावल या बैट मिलाकर दें या सी या तेल मिली खिचड़ी दें। आहार में सब्जियाँ भी मिलाने।
- दूध में कभी बेकिंगी या दलिया या जलवा या सीर या दूध में कभी चुनरी छोड़ें दें
- उबले या लगे हुए आनु या बिना चिर्ब वाली आनु की सब्जी मसालकर दें
- केला या किचुट या पीन्डू या आम या ज्योला बीच बीच में दें
- 1 से 2 साल के बच्चों को पर में बना सब खाना मिलाने

जच्छा बच्छा काऊडे



स्तनपान और ऊपरी आहार सम्बन्धी तरीकों में सुधार

श्री का नाम
पिता का नाम
पता
आपके का नाम
हस्ताक्षर
जन्म तिथि



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
 - Appropriate
 - Enough
 - Offered with love

Detection and management of moderate and severe acute malnutrition



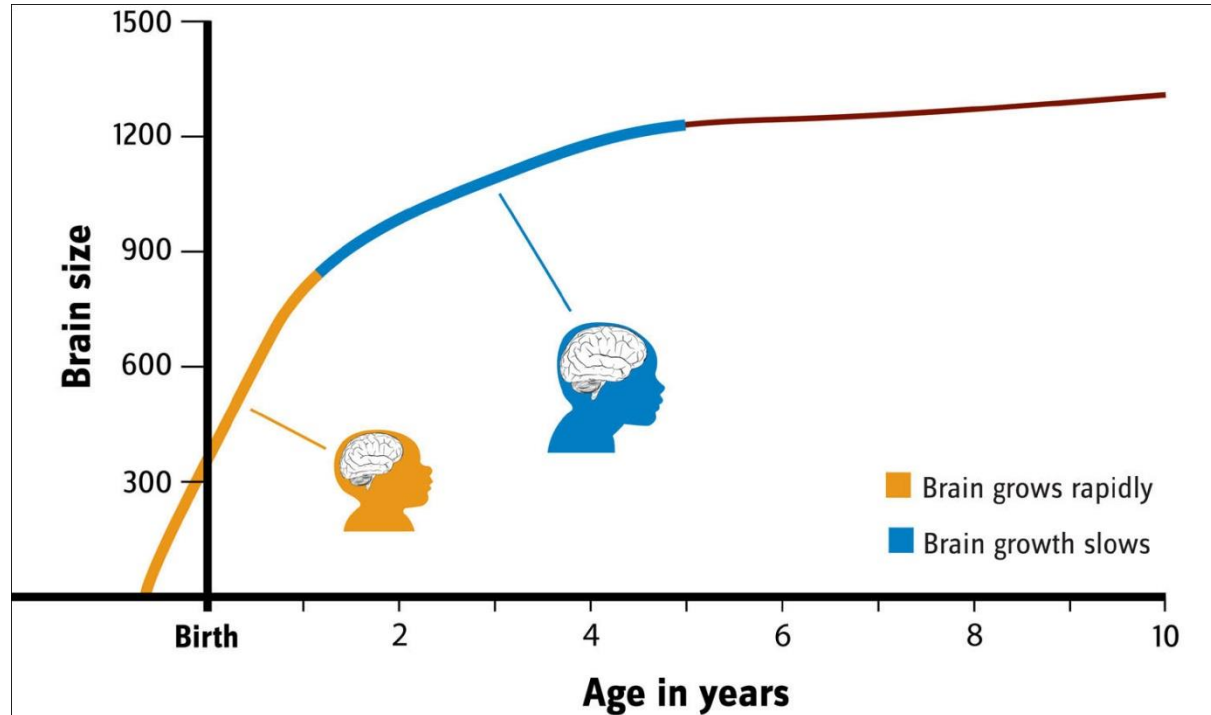
Feeding during the first two years: who is responsible?

1st 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?

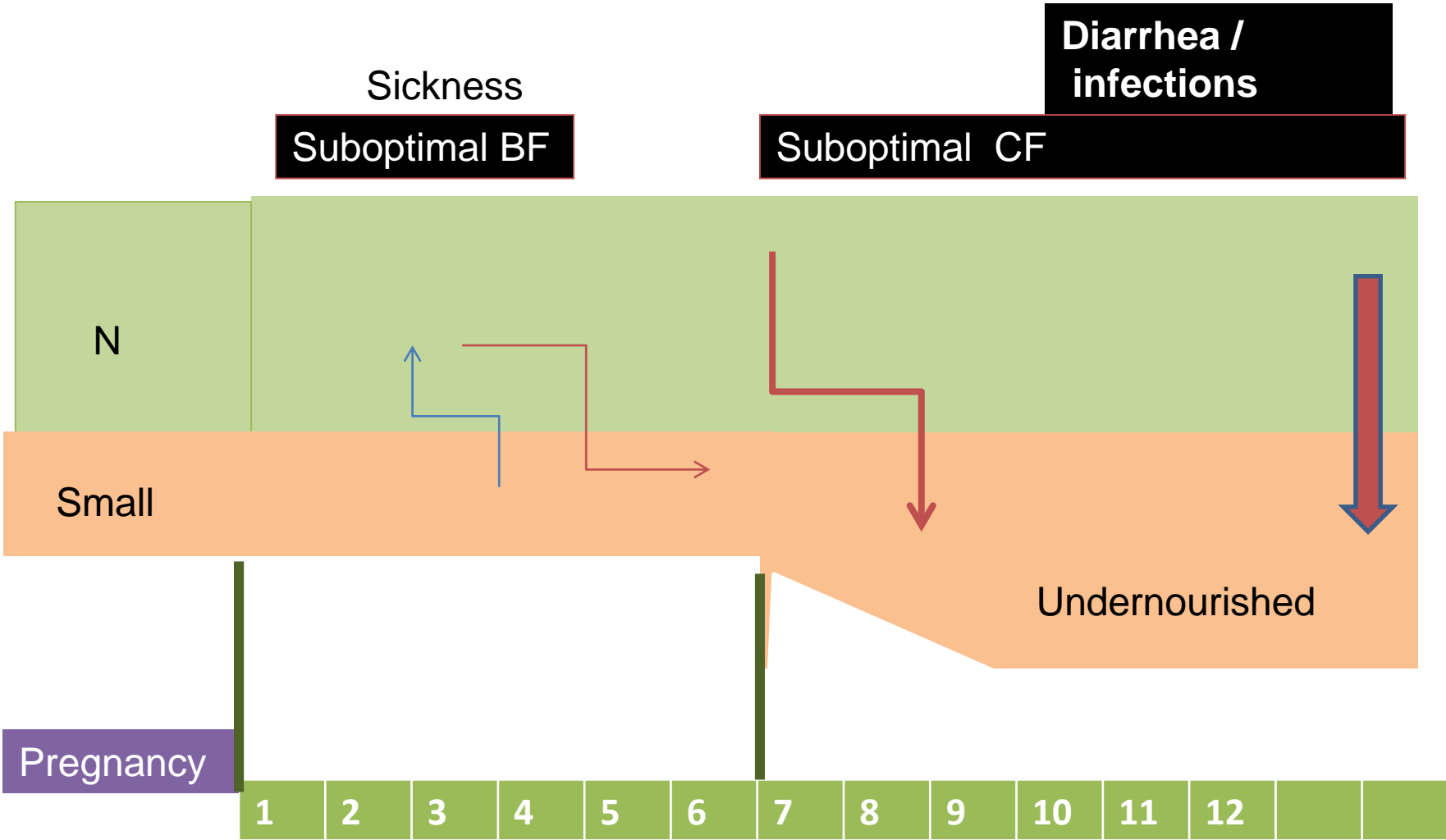
Red = Health; Blue ICDS, Green = both

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

Genetics, epigenetics, maternal nutrition / health



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 do.”***

Goethe



