

INTERNATIONAL SYMPOSIUM ON  
**Understanding the Double Burden of  
Malnutrition for Effective Interventions**

# Complementary Feeding and Growth

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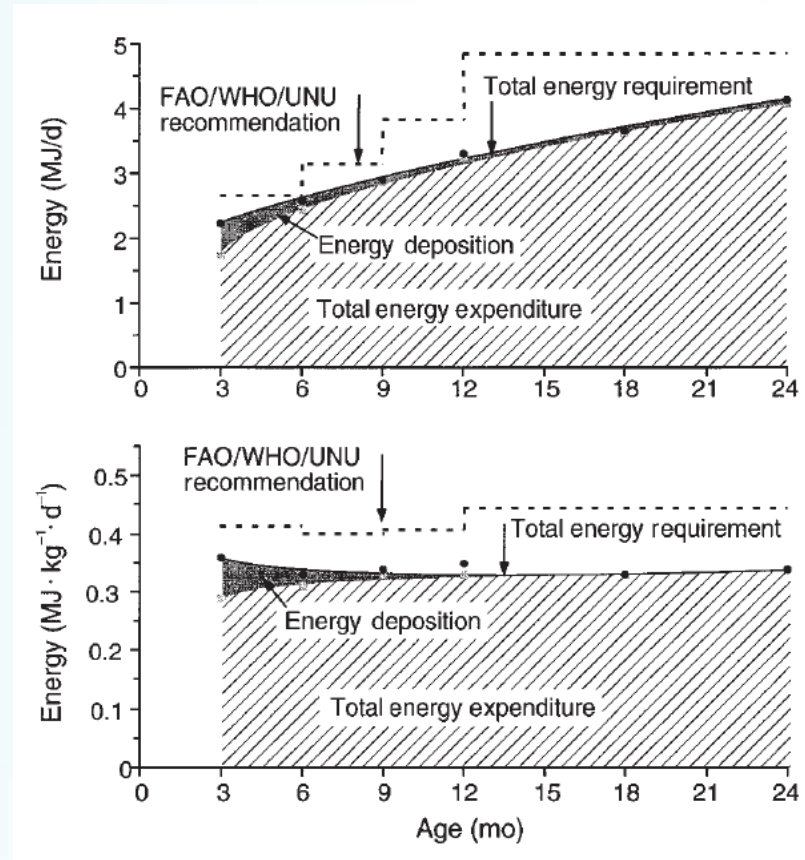
# Complementary Feeding

*“a process starting when breast milk alone is no longer sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids are needed, along with breast milk”*



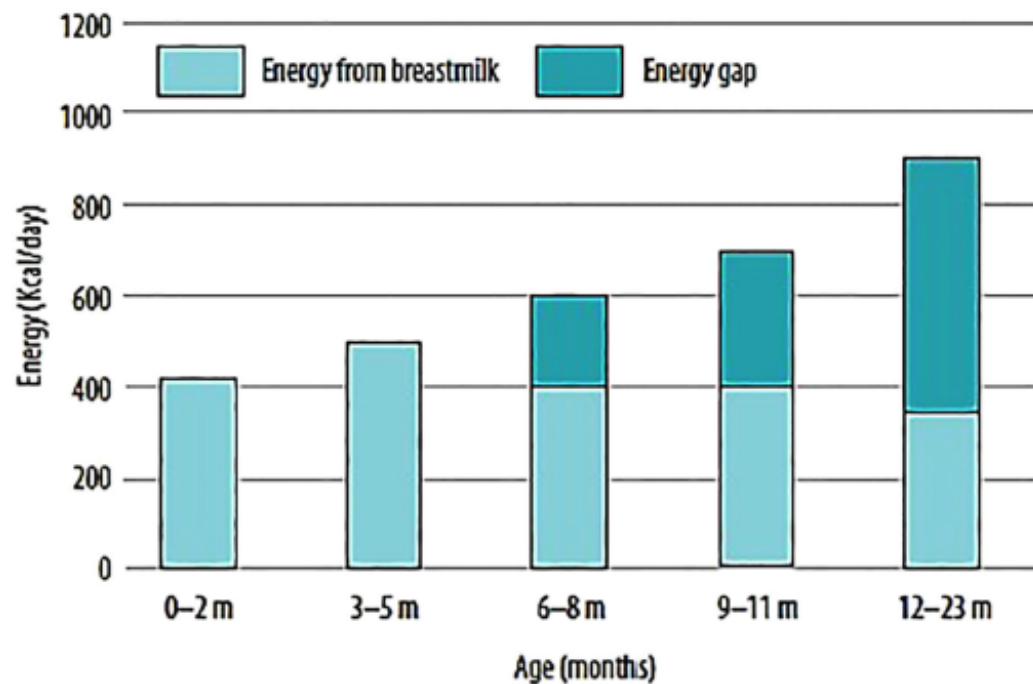
# Energy and Nutrient Costs of Growth

Age (mo)	Fat-free mass (kg)
0.5	3.32 ± 0.50
3	4.34 ± 0.35
6	5.63 ± 0.51
9	6.61 ± 0.59
12	7.56 ± 0.74
18	8.63 ± 0.70
24	9.45 ± 0.74



# Elements of Complementary Feeding

**Energy required by age and the amount from breast milk**

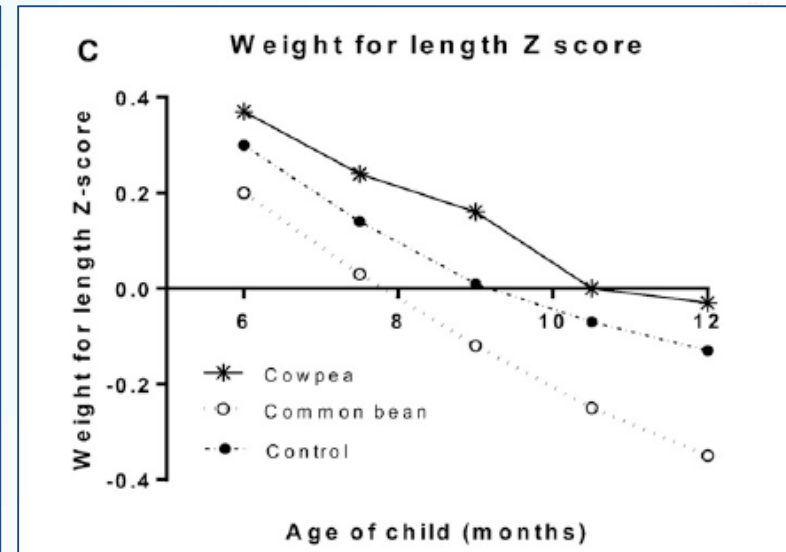
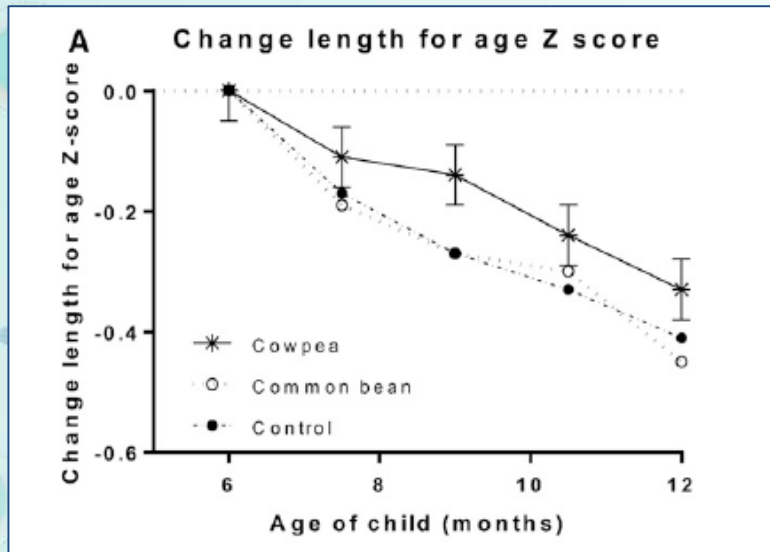


# Elements of Complementary Feeding

Age of infant in months	Birth	1	2	3	4	5	6	7	8	9	10	11	12
Age grouping	Birth to 3 months		4–6 months			6–8 months			8–12 months				
Sequence of introducing foods	Breast milk or infant formula		Complementary			Foods							
Texture of complementary foods			Strained/pureed (thin consistency cereal)										
			Mashed										
			Ground/finely chopped					Chopped					
Feeding style	Breast feeding/bottle feeding												
			Spoon feeding										
			Cup feeding										
													Self-feeding/ feeding finger foods



# Quality of Complementary Feeding and Growth



- RCT between Cowpea CFP and corn-soy CFP
- Growth faltering was less pronounced in the Cowpea v. Control group

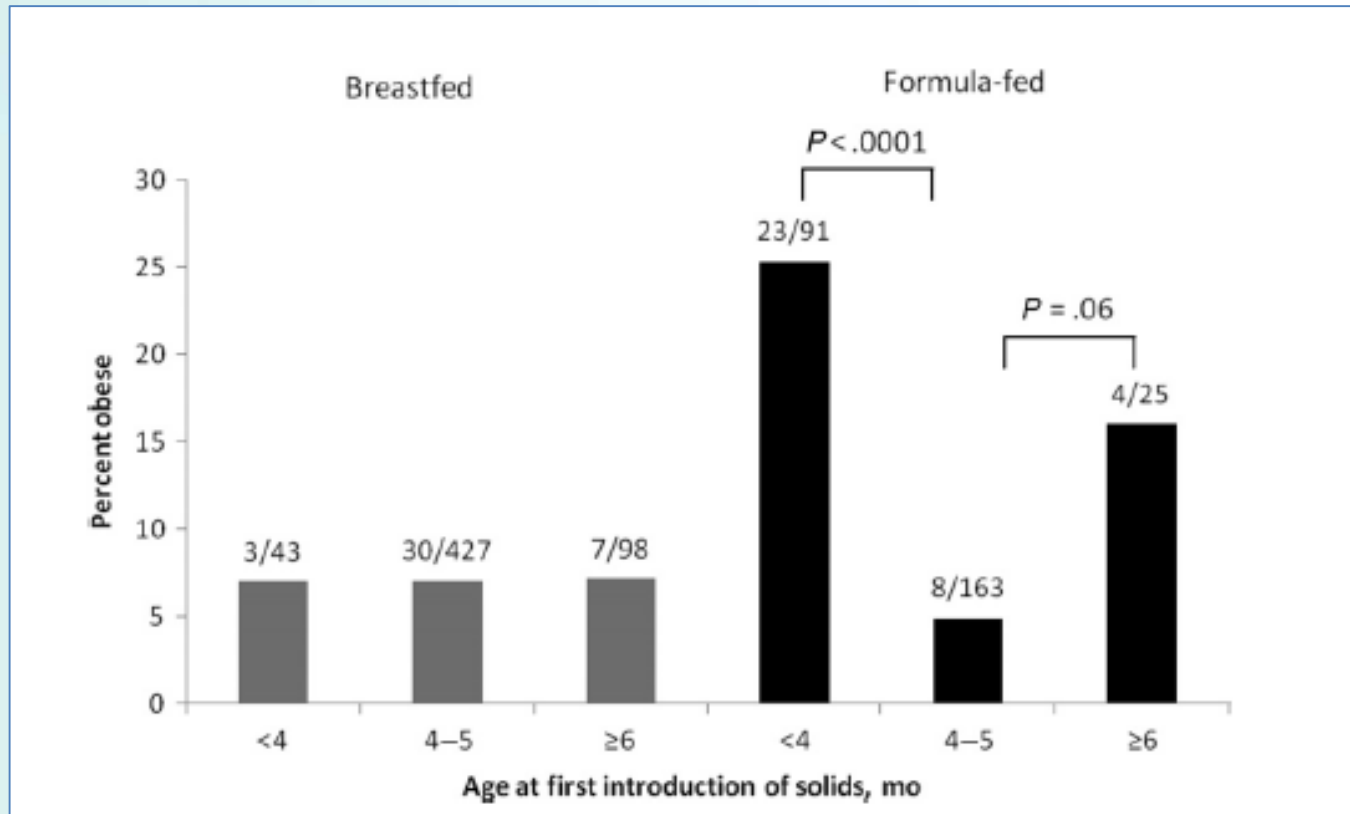
# Complementary Feeding and Body Composition

**Table 4.** Association of duration of full breastfeeding and timing of introduction of complementary feeding with FFM and FM at the age of 5–6 years

	FFM (z)			Model 1 (i)			Model 2 (ii)			FM (z)			Model 1 (i)			Model 2 (ii)		
	mean (s.d.)	B	95% CI	B	95% CI	B	95% CI	mean (s.d.)	B	95% CI	B	95% CI	B	95% CI				
<i>Duration of full breast feeding</i>																		
< 1 m (n=514) ref	-0.01 (1.02)	—	—	—	—	—	—	0.12 (1.11)	—	—	—	—	—	—				
1–3 m (n=575)	0.02 (1.00)	-0.04	-0.12	0.05	0.00	-0.07	0.07	0.03 (1.01)	-0.06	-0.16	0.05	-0.02	-0.11	0.07				
3–6 m (n=698)	0.01 (0.98)	-0.05	-0.14	0.04	0.03	-0.04	0.10	-0.06 (0.93)	-0.09	-0.19	0.01	-0.02	-0.11	0.07				
> 6 m (n=410)	-0.04 (0.99)	-0.17	-0.27	-0.07	0.03	-0.05	0.11	-0.09 (0.94)	-0.20	-0.31	-0.08	-0.03	-0.13	0.08				
<i>Timing of introduction of complementary feeding</i>																		
< 4 m (n=117) ref	0.21 (1.10)	—	—	—	—	—	—	0.32 (1.24)	—	—	—	—	—	—				
4–6 m (n=816)	0.02 (1.00)	-0.13	-0.26	0.01	-0.04	-0.15	0.06	0.07 (1.09)	-0.13	-0.28	0.03	-0.06	-0.19	0.07				
> 6 m (n=1250)	-0.04 (0.99)	-0.16	-0.29	-0.03	-0.02	-0.12	0.09	-0.08 (0.91)	-0.23	-0.39	-0.08	-0.11	-0.25	0.02				

- Breastfeeding longer than 6 mos was associated with lower FM, but results were not statistically significant.
- Later timing of CF was associated with lower FM, but association was not statistically significant after controlling for confounding factors.

# Complementary Feeding and Obesity



- Early introduction of solid foods was associated with obesity only in formula-fed infants.

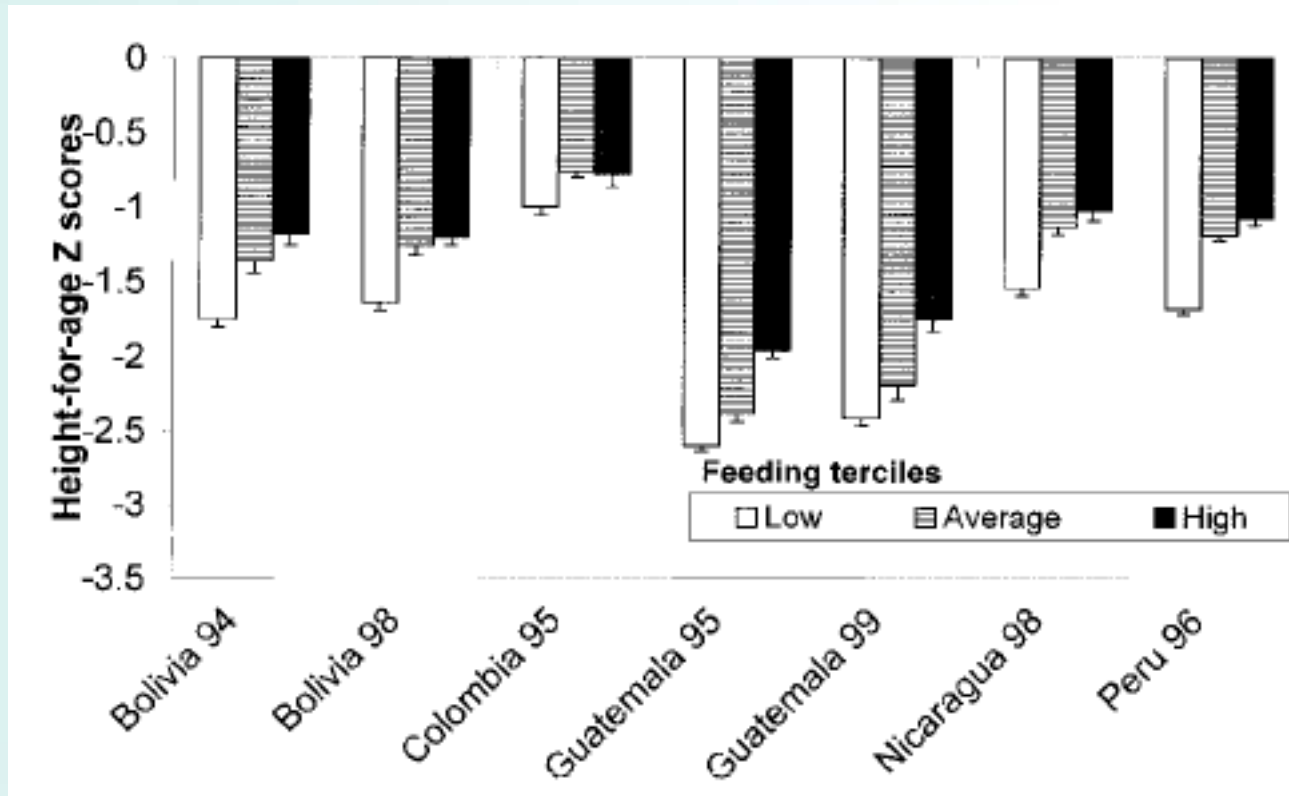


# Complementary Feeding and Obesity

Risk factor	$\beta$	SE	<i>P</i>
Intercept	2.68	0.48	<0.001
BWZ	0.64	0.15	<0.001
$\Delta$ WAZ (0–5 months)	0.73	0.17	<0.001
Sex (0, female; 1, male)	–0.59	0.09	<0.001
<b>Full breastfeeding</b>			
< 1 month	Reference		
1–3 months	–0.04	0.19	0.85
4–5 months	–0.12	0.15	0.42
6 months	0.05	0.27	0.86
<b>Age of introduction</b>			
3–4 months	Reference		
5 months	0.17	0.11	0.15
6 months	0.16	0.23	0.50
<b>BWZ <math>\times</math> full breastfeeding</b>			
< 1 month	Reference		
1–3 months	–0.07	0.21	0.75
4–5 months	–0.13	0.17	0.46
6 months	–0.63	0.24	0.009

- Birth weight Z-score was main predictor of FMI at 3 years of age.
- Length of breastfeeding or timing of CF did not attenuate the effect of BWZ on FMI.

# Complementary Feeding and Stunting



# Effectiveness of Complementary Feeding Programs

## Nutrition education only

Length gain (cm)	Intervention	Control	MD	SMD
7 studies	1361	1140	0.37 (0.10, 0.64)	0.09 (0.02, 0.16)
Food-secure	829	653	0.46 (0.14, 0.77)	0.12 (0.01, 0.24)
Food-insecure	532	487	0.12 (-0.40, 0.64)	0.03 (-0.09, 0.15)

## Nutrition education and food supplements

Length gain (cm)	Intervention	Control	MD	SMD
5 studies	6885	2427	0.29 (0.10, 0.47)	0.09 (0.05, 0.14)

# Effectiveness of Complementary Feeding Programs

Site	Exclusively breastfed (%)		Mean breast-feeding frequency (times/day)	Fed formula regularly <sup>a</sup> (%)	Frequency of complementary feeding (%)		Fed meat <sup>b</sup> regularly (%)	Fed fish, eggs, or dairy regularly (%)
	5 mo	9 mo			1 or 2 times/day	≥ 3 times/day		
Democratic Republic of Congo	12.9	0	14.9	0.3	50.5	44.8	13.0	55.2
Zambia	43.3	1.4	9.7	10.6	44.4	43.2	23.4	61.1
Guatemala	52.3	4.9	9.1	9.2	31.4	43.4	24.6	48.0
Pakistan	17.5	6.9	10.8	23.3	50.7	37.7	22.2	72.5
All sites	30.5	4.1	11.1	14.4	45.1	41.6	21.1	61.1

Site	Total <i>n</i>	Length-for-age		Weight-for-age	
		<i>n</i>	z-score	<i>n</i>	z-score
Democratic Republic of Congo	420	420	-2.8 ± 2.01	418	-1.67 ± 1.59
Zambia	386	380	-1.91 ± 1.43	357	-0.76 ± 1.85
Guatemala	336	336	-2.34 ± 1.51	329	-0.94 ± 0.95
Pakistan	516	512	-1.91 ± 1.74	496	-1.42 ± 2.13
All sites	1,658	1648	-2.22 ± 1.75	1,600	-1.24 ± 1.77

# Influences on Complementary Feeding

	Bolivia 1994	Bolivia 1998	Colombia 1995	Guatemala 1995	Guatemala 1999	Nicaragua 1998	Peru 1996
Feeding index <sup>2</sup>	( <i>P</i> = 0.07)	( <i>P</i> = 0.29)	(interaction)	( <i>P</i> = 0.001)	(interaction)	(interaction)	(interaction)
Child characteristics							
Age	-	+	+	-			
Gender (female)			+	+			+
Maternal characteristics							
Education		+	+	+	+	+	(interaction)
Height	+	+	+	+	+	+	+
Ethnicity (nonindigenous)	NA	NA	NA	+	(interaction)	NA	NA
Parity	-						-
Household characteristics							
Socioeconomic status (SES)	+	+	(interaction)	+		(interaction)	+
Number of children < 5 y	-	-	-	-	-	-	-
Rural residence	-	-		-	-	-	-
Two way interaction between feeding index and <sup>3</sup> :			SES ( <i>P</i> = 0.02)		Maternal ethnicity ( <i>P</i> = 0.001)	SES ( <i>P</i> = 0.01)	Maternal schooling ( <i>P</i> = 0.06)

# Challenges to Complementary Feeding Programs

- Lack of evidence from randomized trials in humans.
- Minimize lag time between exposure and outcomes
- Food composition changes over time
- Need for more accurate assessment of breastfeeding and dietary intake
- Pathways may differ by outcomes studied
- Improve understanding of role of microbiota in growth



# Summary

- Complementary foods must be introduced at the appropriate time, with appropriate nutrient-dense foods
- Feeding programs should emphasize the importance of timing and quality of complementary feeding.
- More explicit research on the most effective manner to promote complementary feeding is needed.
- Consider alternatives to using “stunting” as primary outcome.

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 Suksama  
 Misaotra  
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