

Growth and body composition of term healthy Indian infants from birth to 2 years of age

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Background

- The average birth weight in India is amongst the lowest in the world, whereas, the prevalence of visceral adiposity, type 2 diabetes and cardiovascular disease is the highest. This paradox may be partially explained by an accelerated pattern of weight gain in early infancy.
- While fetal growth restriction constrains lean mass and metabolic capacity, accelerated growth in early infancy or 'catch-up growth' is associated with a preferential gain in fat mass rapid growth in infancy/ childhood brings about greater gain in fat mass and higher metabolic load.

Objectives

- To assess the growth pattern and body composition of term healthy breastfed babies from birth to 2 years.
- To compare the fat mass (FM)% assessed by deuterium dilution technique and skinfold thicknesses.
- To assess the impact of catch-up growth from birth to 3 mo on FM% till 2 y.
- To compare the growth and body composition of low and normal birth weight babies till 2 y.

Subjects and Methods

- Term singleton newborns, with birth weight between 1800-4000 grams, with no congenital anomalies or neonatal illness were recruited at birth from AIIMS, New Delhi.
- Anthropometry, including measurement of skinfold thickness at biceps, triceps, subscapular and supra-iliac sites by Holtain's callipers, was done serially at birth, 10 days, 3.5 months, 1 and 2 years of age.
- Body composition assessment by deuterium dilution method was done in a subset of infants at 10 days, 3 months, 1 and 2 years.
- Deuterium oxide (D₂O) was administered orally at a dose of 0.05 mg/kg, and urine samples were collected prior to and at 4 and 5 hours after the dose. Concentration of deuterium was measured by isotope ratio mass spectrometry.
- Total body water was calculated from the plateau enrichment at 4 and 5 h post dose, and fat-free and fat mass (FM) were calculated using known hydration factors.
- FM% was also calculated from the sum of skinfolds using equations proposed by Weststrate and Deurenberg (Am J Clin Nutr, 1989).

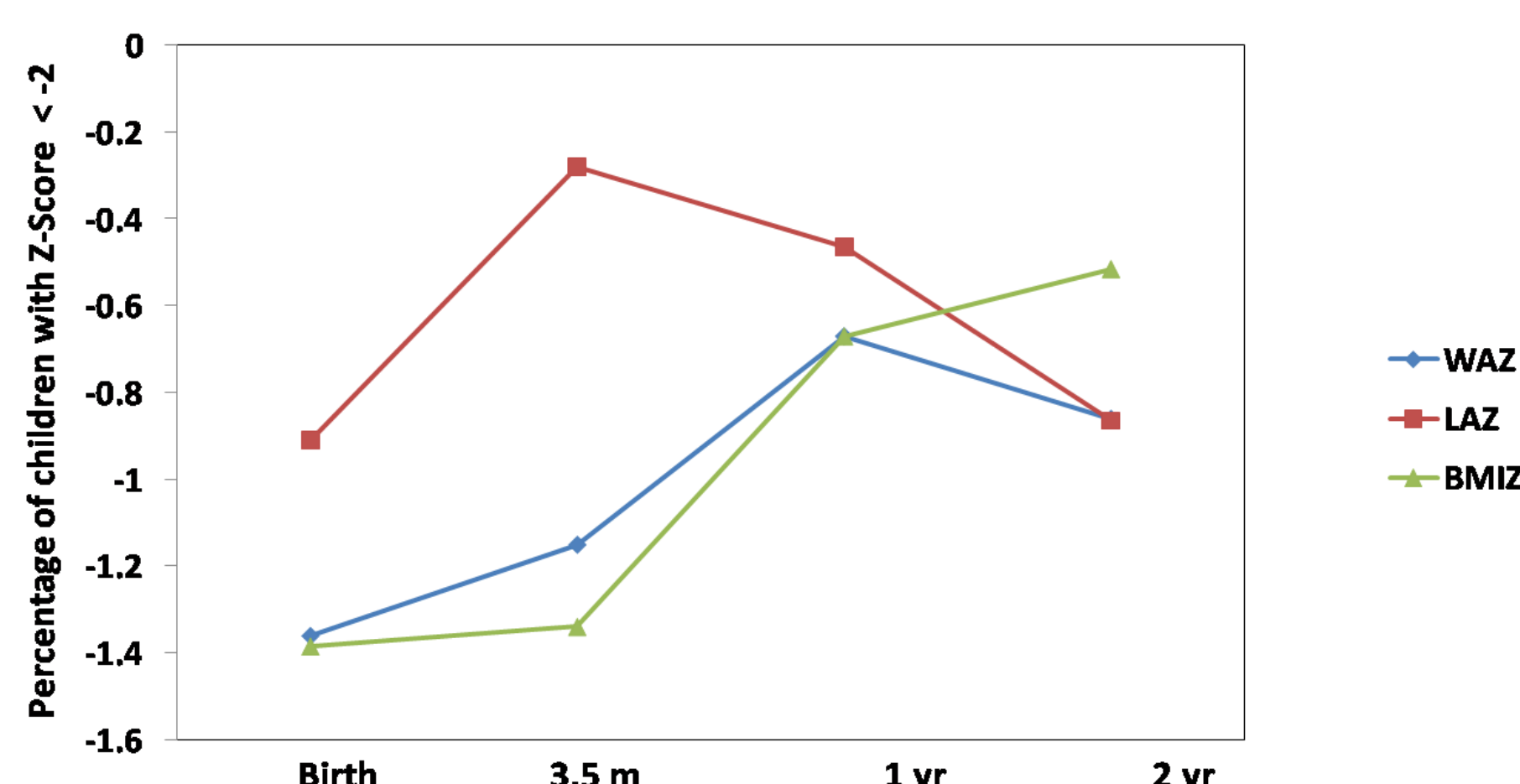
Results

Table 1. Serial anthropometric data from birth to 2 years

Parameters	At birth	3.5 Months	1 Year	2 Years
N	276	217	223	186
Age (Days)	0-2	102 ± 14	400 ± 25	743 ± 32
Weight (Kg)	2.9 ± 0.4	5.6 ± 0.8	9.0 ± 1.3	11.0 ± 1.4
WAZ [#]	-1.3 (-4.0 - 0.9)	-1.2 (-4.7 - 1.8)	-0.7 (-3.1 - 2.9)	-0.9 (-3.2 - 2.5)
WAZ <-2*	60 (21.4)	38 (17.5)	24 (10.8)	22 (11.8)
Length (cm)	48.4 ± 2.2	61.0 ± 3.1	75.2 ± 3.1	84.6 ± 3.2
LAZ [#]	-0.9 (-4.2 - 2.9)	-0.3 (-3.9 - 3.3)	-0.5 (-4.1 - 3.0)	-0.9 (-3.8 - 1.6)
LAZ <-2*	40 (14.5)	23 (10.6)	19 (8.5)	18 (9.6)
BMI	11.7 ± 1.3	15.0 ± 1.8	15.9 ± 1.8	15.3 ± 1.6
BMIZ [#]	-1.4 (-5.0 - 1.7)	-1.3 (-5.6 - 2.2)	-0.7 (-3.9 - 2.9)	-0.5 (-3.6 - 3.9)
BMIZ <-2*	81 (29.3)	62 (28.6)	20 (9.0)	16 (8.6)
FM% calculated from skin fold thicknesses	14.4 ± 3.5	24.0 ± 3.1	21.7 ± 3.2	20.1 ± 2.9

Median (range), * N (%)

Figure 1. Growth pattern from birth to 2 years in terms of z scores



- The median z-scores were negative at all four time points but showed a significant improvement from birth to 3 months.
- LAZ showed a decline at 1 and 2 years of age, with corresponding improvement in BMIZ.

Table 2. FM% by deuterium and skinfold thickness

Age	10 days	3.5 mo	1 yr	2 yr
N	129	163	70	82
Weight (Kg)	3.0 ± 0.5	5.6 ± 0.8	9.0 ± 1.2	11.0 ± 1.4
FM% from skin fold thickness	17.7 ± 3.1	24.1 ± 3.2	22.3 ± 3.6	20.2 ± 2.7
FM% by deuterium	11.5 ± 7.2	21.2 ± 7.6	17.7 ± 8.3	25.7 ± 10.1
Correlation between FM% by skinfold deuterium (Rho)	0.045	0.089	0.227	0.166
P-value	0.614	0.259	0.060	0.140

FM% did not differ by gender

Figure 2. FM% by skinfolds and deuterium

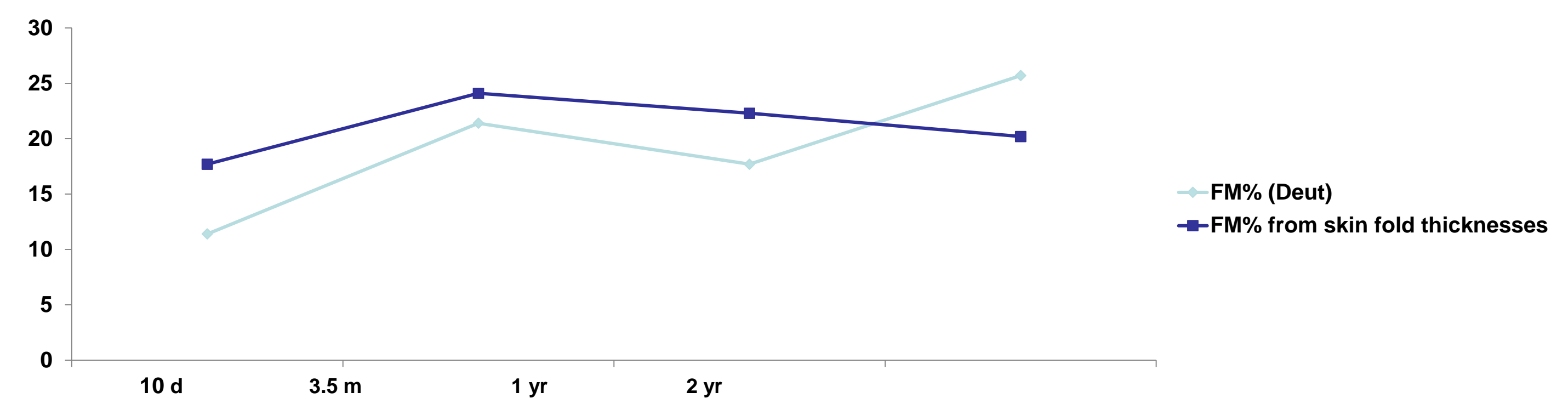


Table 3. Correlation of FM% with anthropometric measurements

Parameter	FM% by deuterium		FM% by skinfold thickness	
	rho	p	rho	P
At birth	N=127		N=241	
WAZ	0.176	0.048	0.643	<0.001
LAZ	-0.025	0.782	0.453	<0.001
BMIZ	0.121	0.171	0.388	<0.001
At 3 months	N=161		N=213	
WAZ	0.171	0.030	0.538	<0.001
LAZ	-0.098	0.217	0.280	<0.001
BMIZ	0.260	0.001	0.212	<0.001
At 1 y	N=70		N=222	
WAZ	0.252	0.034	0.485	<0.001
LAZ	0.181	0.136	0.094	0.162
BMIZ	0.183	0.127	0.540	<0.001
At 2 y	N=81		N=185	
WAZ	0.149	0.182	0.482	<0.001
LAZ	0.193	0.084	0.144	0.051
BMIZ	0.086	0.444	0.527	<0.001

Table 4. Comparison of FM% and anthropometry from birth to 2 years in low and normal birth weight babies

Parameter/ Time	BW < 2500 g		BW ≥ 2500 g		P-value
	N	Mean ± SD/ Median (range)	N	Mean ± SD/ Median (range)	
FM% _{D2O} at birth	16	10.4 ± 5.4	100	11.6 ± 7.7	0.90
FM% _{D2O} at 3.5 m	26	21.8 ± 9.4	125	21.3 ± 6.6	0.75
FM% _{D2O} at 1 y	17	13.2 ± 5.9	51	19.4 ± 8.3	0.004
FM% _{D2O} at 2 y	11	31.3 ± 6.6	70	24.7 ± 10.3	0.011
FM% _{skf} at birth	40	14.8 ± 3.7	178	17.2 ± 3.1	<0.001
FM% _{skf} at 3.5 mo	38	22.9 ± 3.7	158	24.3 ± 3.0	0.016
FM% _{skf} at 1 y	39	21.6 ± 3.0	162	21.9 ± 3.3	0.573
FM% _{skf} at 2 y	32	20.2 ± 2.4	154	20.2 ± 3.0	0.831
WAZ at 3.5 m	38	-1.2 (-4.7 - -0.6)	157	-0.9 (-3.5 - 1.8)	<0.001
WAZ at 1 yr	38	-0.8 (-0.3 - 1.3)	162	-0.6 (-2.9 - 2.9)	0.031
WAZ at 2 yr	31	-1.0 (-2.8 - 1.1)	154	-0.7 (-3.2 - 2.5)	0.079
LAZ at 3.5 m	36	-1.3 (-3.5 - 3.4)	157	-0.1 (-3.9 - 3.7)	<0.001
LAZ at 1 yr	38	0.7 (2.5 - 1.23)	161	-0.3 (-4.1 - 3.0)	0.039
LAZ at 2 yr	32	-1.0 (-3.5 - 1.3)	154	-0.9 (-3.8 - 1.59)	0.423
BMIZ at 3.5 m	36	-1.8 (-5.6 - 0.4)	157	-1.3 (-5.5 - 2.2)	0.004
BMIZ at 1 yr	38	-0.7 (3.3 - 2.1)	161	-0.7 (-3.9 - 2.9)	0.312
BMIZ at 2 y	32	2.2 (1.4 - 3.0)	154	2.4 (1.4 - 3.4)	0.006

- Catch up growth (CUG) was defined as ΔWAZ (3.5 mo-birth) ≥ 0.67. Out of 216 infants for whom anthropometric data was available at birth as well as 3 months, CUG was present in 65 (30.9 %).

- FM% by skinfolds was higher in infants with CUG at 3.5 mo and 2 y. ΔWAZ showed a positive correlation with FM% at 3.5 mo, 1 y as well as 2 y

Table 5. Catch-up growth in early infancy: Effect on FM%

Time	Comparison of means between those with or without CUG				Correlation between Δ WAZ and FM%			
	Without CUG		With CUG		P-value	N	Rho	P
	N	FM %	N	FM%				
3 mo	150	23.4 ± 3.1	64	25.3 ± 2.7	<0.001	214	0.42	<0.001
1 y	141	21.6 ± 3.1	55	22.3 ± 2.9	0.15	196	0.22	0.002
2 y	123	19.9 ± 2.8	44	20.8 ± 2.3	0.06	167	0.18	0.018

Conclusions

- The growth pattern was characterized by low z-scores for length as well as weight at birth, catch-up in length as well as weight by 3.5 mo, followed by deceleration in length between 3.5 mo to 2 y, and in weight between 1 yr to 2 yr.
- Magnitude of change in weight z-score between birth - 3.5 m was positively correlated with FM% at 3.5m, 1 y and 2 y
- FM% measured by skinfolds and deuterium showed poor correlation
- FM% assessed by skinfolds was strongly correlated with WAZ, LAZ as well as BMIZ at all time points
- LBW infants had comparable FM% to normal BW infants at 2 y, when assessed by skinfold thickness and higher when assessed by deuterium. WAZ and LAZ were lower compared to normal BW infants, but BMIZ was comparable at yr.
- Low birth weight as well as accelerated weight gain in early infancy may contribute to development of greater adiposity in Indians.