

A prospective study of the pattern of growth of low birth weight babies from birth to 6 months of age

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Abstract

Introduction: Low birth weight (LBW) is defined as birth weight less than 2500g, irrespective of the period of gestation.

Objectives: To assess the growth parameters and their pattern among LBW babies from birth to 6 months as compared to WHO standards for normal birth weight (NBW) babies.

Method: This was a longitudinal observational study. All admitted newborn babies (in-born and out-born) in a tertiary care hospital from 1st November 2016 to 31st October 2017 who met inclusion and exclusion criteria were taken as cases. Serial anthropometric assessments were done at birth and during immunization visits (1½, 2½, 3½ months and 6 months). This was compared against the WHO standards for NBW babies.

Results: The birth weight among the males had a mean of 2390g and among the females a mean of 2163g. The average growth rate was observed to be lower in the LBW babies in the first two months after which the average growth rate increased. The rate of increase in length was always higher among the LBW babies. There was a lag in the increase of head circumference in the first month after which the rate of increase was higher among the LBW babies as compared to NBW babies.

Conclusions: In this study LBW babies had a lag in the growth in the first month after which the rate of growth was significantly higher than in NBW babies.

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(Key words: Low birth weight, weight, length, head circumference)

Introduction

Low birth weight (LBW) is defined as birth weight less than 2500g, irrespective of the period of gestation¹. It includes preterm babies and small for date babies, which in turn includes small for gestational age and intrauterine growth restriction (IUGR)¹. Incidence of LBW babies and preterm babies in India are 28% and 12% respectively¹. The outcome of uncomplicated premature babies is comparable to the babies born after full maturity¹. Their physical growth correlates better with their conceptional age rather than the age calculated from the date of birth¹. Preterm appropriate for date babies catch up in their physical growth with term counterparts by the age of 1-2 years¹.

Some studies have shown that the smaller babies have late and poor catch up growth², whereas some studies state that small babies have good catch up growth³. There is no consensus on the pattern of growth among LBW babies². Evaluation of growth in LBW infants should be more emphasized since growth failure in such infants might be associated with many complications, including increasing the number of hospitalizations, learning disabilities and growth retardation in childhood². World Health Organisation (WHO) gathered data from 8440 healthy breastfed infants from widely diverse ethnic backgrounds and produced a standard to be used as a reference⁴.

Objectives

To assess the growth parameters (weight, length and head circumference) and their pattern among LBW babies from birth to 6 months as compared to WHO standards for normal birth weight babies.

Method

Study design: Longitudinal observational study

Source of data: All newborn babies admitted (in-born and out-born) in a tertiary care hospital from 1st November 2016 to 31st October 2017.

Sample size: This was calculated using the formula:

$$n = \frac{Z\alpha^2 p (1-p)}{e^2}$$

Sample size was calculated to be 96 with an incidence of 28%, 9% error and confidence interval of 95%. Total sample size taken was 100.

Inclusion Criteria:

All babies weighing <2500g, irrespective of gestational age admitted at the parent institute within 7 days of life.

Exclusion Criteria:

1. All babies who are lost to follow up. A minimum of three visits are mandatory, the third being the visit at 6 months
2. Babies born with major congenital anomalies
3. Birth weight <1500g - Very low birth weight babies
4. Babies whose parents did not consent

All babies fulfilling inclusion criteria were part of the study. LBW is defined as birth weight less than 2500g, irrespective of the period of gestation. Informed consent was taken from the parents. Contact details were obtained to enable regular follow up. Anthropometric measurements were taken with hygienic precautions.

Anthropometric measurements of babies:

In-born babies: length, weight and head circumference (HC) of the babies born at the parent institute were measured on the day of birth.

Out-born babies: length and HC were taken on the day of admission (less than 7th postnatal day). Weight recorded was the birth weight.

Children were reviewed at the immunization visits-chronological age of 1½, 2½, 3½ months and 6 months and anthropometric measurements were

documented. A grace period of ±2 weeks was given in view of practical difficulties.

All babies were weighed by children’s digital weighing scale (to nearest 10g). The supine crown heel length was measured on the infantometer to the nearest mm. HC was measured using a flexible non-stretchable tape (up to the nearest mm) across the supraorbital ridge to the posterior occipital protuberance.

For comparison of growth parameters, the WHO growth standard values were used⁴.

Ethical issues: Ethical approval was obtained from the Father Muller Institutional Ethics Committee, Kankanady, Mangalore, Karnataka, India (No, FMMC/FMIEC/4013/2016). Informed consent was taken from parents of all babies who were part of the study

Results

A total of 142 LBW babies were recruited for the study, but 42 babies were lost to follow up. The net sample size was 100 out of which 41 were females and 59 were males.

Weight

Table 1 shows the mean weights of LBW babies and WHO standard for NBW babies at birth, 1.5 months, 2.5 months, 3.5 months and 6 months. At every time interval, the mean weight among the males was higher than the mean weight among the females.

Table 1: Mean weights of low birth weight (LBW) babies and World Health Organisation (WHO) standard for normal birth weight (NBW) babies at birth, 1.5 months, 2.5 months, 3.5 months and 6 months

Time interval	Gender	Mean weight of LBW babies (g)	Standard deviation	Mean weight of NBW babies WHO standard (g)	t
Birth	Male	2390.7	124.00	3300	-56.32
	Female	2163.9	114.58	3200	-57.902
1.5 months	Male	3407.2	140.121	4900	-81.83
	Female	3197.34	133.26	4600	-67.4
2.5 months	Male	4301.68	147.5	5800	-78.02
	Female	4089.88	164.73	5400	-50.93
3.5 months	Male	5222.54	169.519	6600	-62.415
	Female	5018.29	158	6000	-39.78
6 months	Male	7067.2	187.84	7900	-34.055
	Female	6823.54	177.1	7300	-17.227

Table 2 shows the average increase in weight from birth to 1.5 months among the LBW male and female babies as compared to WHO standards for NBW babies.

From birth to 1.5 months, the average growth among LBW male and female babies was found to be lower than the WHO standard for growth of NBW male and female babies with a weight gain of 22.5g/day and 22.9g/day as compared to an expected weight gain of 35.5g/day and 31.1g/day, respectively.

Table 3 shows the average increase in weight from 1.5 to 2.5 months among the LBW babies as compared to WHO standards for NBW babies.

From 1.5 to 2.5 months, the growth of LBW babies was observed to be similar to the WHO standard.

Table 2: Average increase in weight from birth to 1.5 months among low birth weight (LBW) male and female babies compared to WHO standards for normal birth weight (NBW) babies

Time interval	Gender	LBW babies (g)	Increase/ day g/day	WHO standard (g)	Increase/ day g/day	p-value
Mean increase in weight from birth to 1.5 months	Male	1016.44	22.5	1600	35.5	p<0.001
	Female	1033.44	22.9	1400	31.1	p<0.001

WHO: World Health Organisation

Table 3: Average increase in weight from 1.5 months to 2.5 months among the low birth weight (LBW) babies as compared to WHO standards for normal birth weight (NBW) babies

Time interval	Gender	LBW babies (g)	Increase/ day g/day	WHO standard (g)	Increase/ day g/day	p-value
Mean increase in weight from 1.5 to 2.5 months	Male	894.47	29.8	900	30	0.479
	Female	892.54	29.7	800	26.6	p<0.001

WHO: World Health Organisation

Table 4 shows the average increase in weight from 2.5 to 3.5 months among the male and female LBW babies as compared to WHO standards for NBW babies.

From 2.5 to 3.5 months the growth among the LBW male and female babies was significantly higher with a weight gain of 30.7g/day and 30.9g/day, in contrast to a mean of 26.6g/day and 23.3g/day respectively

Table 4: Average increase in weight from 2.5 to 3.5 months among the male and female low birth weight (LBW) babies as compared to WHO standards for normal birth weight (NBW) babies

Time interval	Gender	LBW babies (g)	Increase/ day g/day	WHO standard (g)	Increase/ day g/day	p-value
Mean increase in weight from 2.5 to 3.5 months	Male	920.86	30.6	800	26.6	p<0.001
	Female	928.41	30.9	600	20	p<0.001

WHO: World Health Organisation

Table 5 shows the average increase in weight from 3.5 to 6 months among the male and female LBW babies as compared to WHO standards for NBW babies.

From 3.5 to 6 months the average increase in weight was 24.5g/day and 24g/day among LBW male and female babies, which was also significantly higher than the WHO standards of 17.3g/day and 16g/day respectively.

Table 5: Average increase in weight from 3.5 to 6 months among the male and female low birth weight (LBW) babies as compared to WHO standards for normal birth weight (NBW) babies

Time interval	Gender	LBW babies (g)	Increase/ day g/day	WHO standard (g)	Increase/ day g/day	p-value
Mean increase in weight from 3.5 to 6 months	Male	1844.66	24.5	1300	17.3	p<0.001
	Female	1805.24	24	1200	16	p<0.001

Figure 1 shows the comparison of mean gain in weight from birth to 6 months among the low birth weight male and female babies as compared to the

WHO standard. There is no significant difference between the pattern of growth between male and female babies.

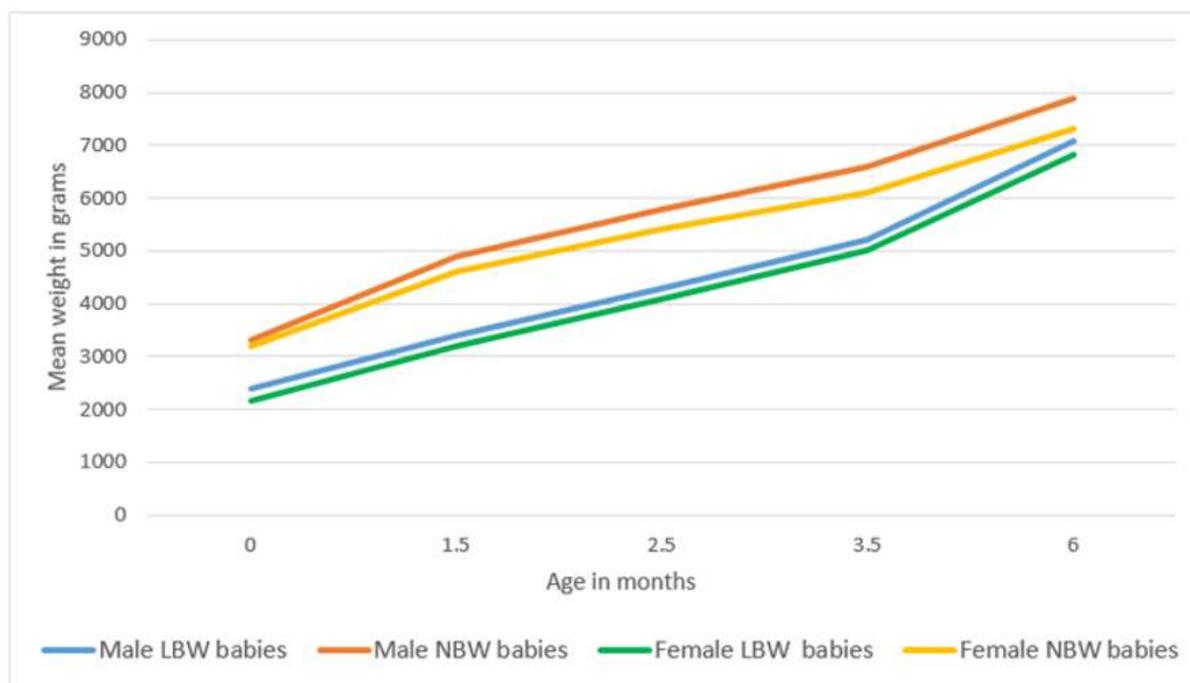


Figure 1: Mean weight of normal birth weight (NBW) male and female (WHO standards) compared to low birth weight (LBW) male and female babies from birth to 6 months

Length

We observed that the average increase in length among LBW babies was significantly higher than that of the WHO standard for normal birth weight babies at all given intervals – from birth to six months.

Table 6 shows the mean, standard deviation and the t-scores for the length of LBW babies at different ages.

Table 7 shows the average increase in length from birth to 6 months among the LBW babies compared to the WHO standards for NBW babies.

Table 6: Mean, standard deviation and t scores for length of low birth weight (LBW) babies at different ages

Age	Mean length of LBW babies(cm)	Standard deviation	Standard length of NBW (cm)	t
Birth	44.746	1.78419	50	-29.448
1.5 months	50.652	2.08247	55	-20.879
2.5 months	54.405	2.0532	58.5	-19.944
3.5 months	58.16	2.16361	62	-17.748
6 months	64.51	2.20305	66.5	-9.033

NBW: Normal birth weight

Table 7: Average increase in length from birth to 6 months among the low birth weight (LBW) babies compared to the WHO standards for normal birth weight (NBW) babies

Time interval	Average increase in LBW babies (cm)	Average increase WHO standard (cm)	Standard deviation	t	p
Birth to 1.5 months	5.90	5	1.52	5.92	<0.001
1.5 to 2.5 months	3.76	3.5	0.42	6.19	<0.001
2.5 to 3.5 months	3.75	3.5	0.58	4.4	<0.001
3.5 to 6 months	6.32	4.5	0.69	25.98	<0.001

WHO: World Health organisation

Figure 2 is a line graph representation of the pattern of increase in length for LBW babies as compared to WHO standards for NBW babies. It shows the mean length of NBW babies (WHO standards) and LBW babies from birth to 6 months.

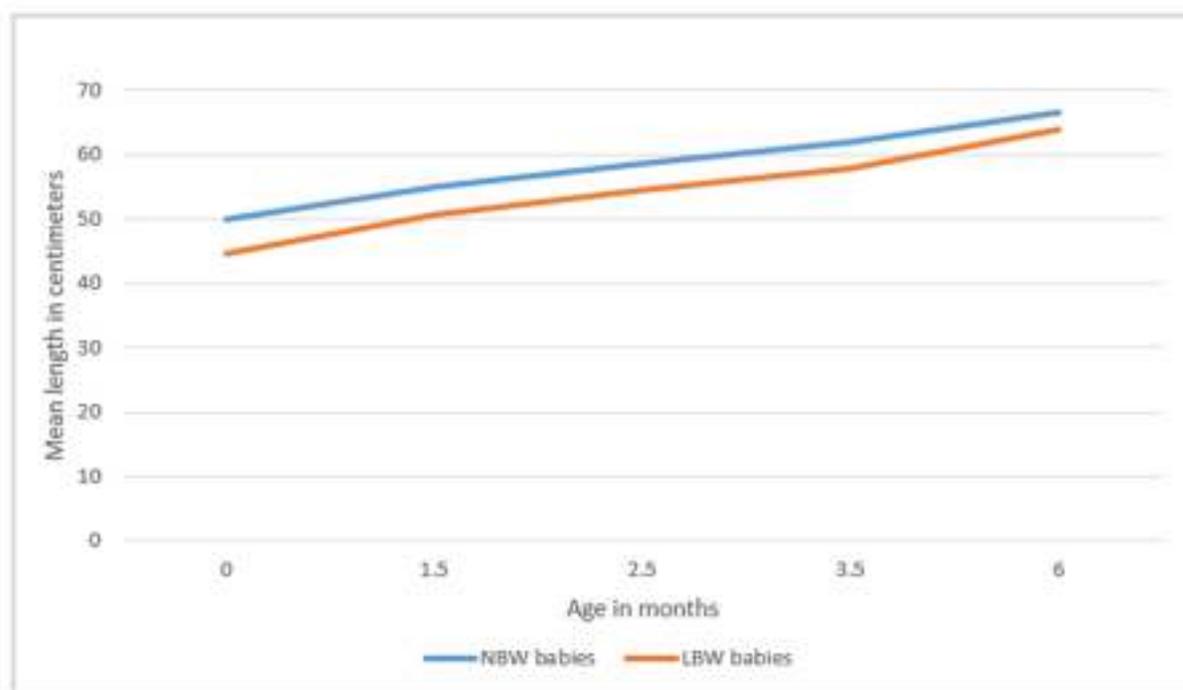


Figure 2: Mean length of normal birth weight (NBW) babies (WHO standards) and low birth weight (LBW) babies from birth to 6 months

Head Circumference

At all ages, the HC was significantly lower than that of the NBW babies. However there was no significant difference between males and females.

Table 8 shows the mean HC of LBW babies and WHO standard for NBW babies at different ages.

Table 9 shows the average increase in HC from birth to 6 months among the LBW babies as compared to WHO standards for NBW babies.

Table 8: Mean head circumference (HC) of low birth weight (LBW) babies and WHO standard for normal birth weight (NBW) babies at different ages

Age	Mean HC of LBW babies(cm)	Standard deviation	Mean HC WHO standard (cm)	t
Birth	31.415	1.59554	35	-22.469
1.5 months	34.29	1.59731	38	-23.226
2.5 months	36.51	1.656	40	-21.075
3.5 months	38.555	1.61417	42	-21.342
6 months	41.975	1.7106	45	-17.684

WHO: World Health organisation

Table 9: Average increase in head circumference from birth to 6 months among the low birth weight (LBW) babies as compared to WHO standards for normal birth weight (NBW) babies

Time interval	Mean increase in LBW babies (cm)	Mean increase WHO standard (cm)	Standard deviation	t	p
Birth to 1.5 months	2.87	3	0.53	-2.57	<0.01
1.5 to 2.5 months	2.22	2	0.34	6.41	<0.001
2.5 to 3.5 months	2.03	2	0.29	1.029	0.3
3.5 to 6 months	3.43	3	0.45	9.4	<0.001

Among the LBW babies, the average increase in HC from birth to 1.5 months was significantly lower than the NBW babies. The average gain in HC from 1.5 to 2.5 months was significantly higher than the rate of growth of normal weight babies ($p < 0.001$). There was no significant difference in the

mean increase in the HC 2.5 to 3.5 months. However, the average increase in HC from 3.5 to 6 months was significantly higher. Figure 3 shows the mean HC of NBW babies (WHO standards) and LBW babies from birth to 6 months.

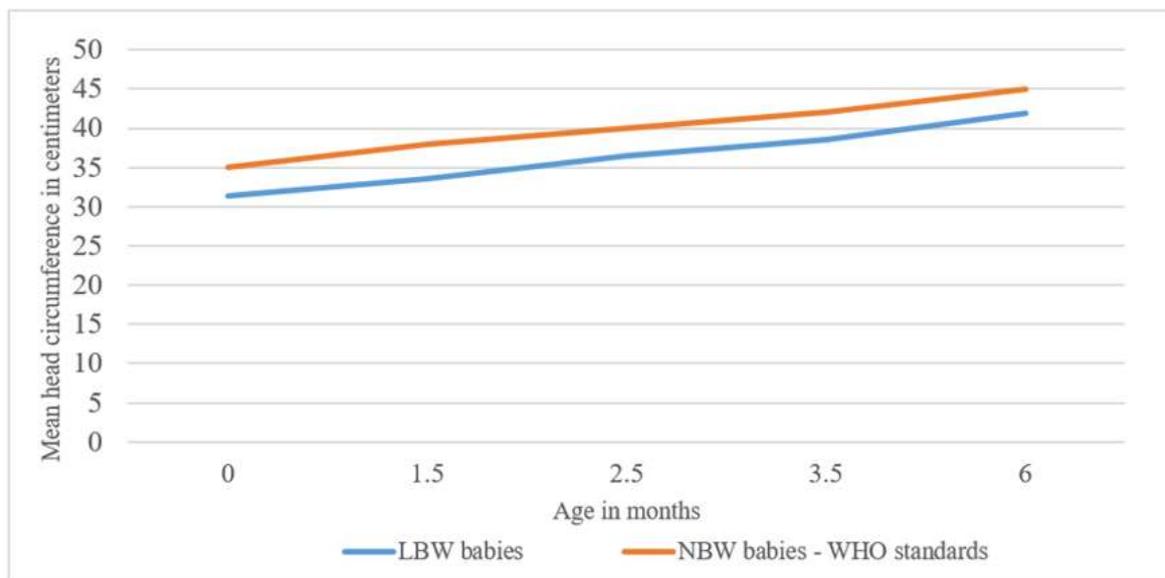


Figure 3: Mean head circumference of normal birth weight (NBW) babies (WHO standards) and low birth weight (LBW) babies from birth to 6 months

Discussion

From birth to 1.5 months, the average increase in weight among the LBW babies was significantly lower than the NBW babies, after which they had similar increase in the next one month. Following that, the average growth from 2.5 to 6 months was significantly higher in the LBW than the NBW babies. This could possibly reflect catch up growth. A similar study was done by Paul B, *et al*⁵ among 126 babies, where 36 were LBW and 90 were NBW. A serial assessment of the mean increments of weight calculated each month from birth to six months was done. They observed that the LBW infants had higher increments as compared to the NBW infants for each month except the 2nd month and 72.2% caught up by 6th month. In a study conducted by Borah M, *et al*⁶, it was also found that the LBW babies had higher rate of weight gain during the first 6 months of age but always remained significantly lighter than the NBW infants. Dorn C, *et al*⁷ investigated perinatal parameters of term small for gestational age (SGA) neonates and observed that SGA babies had a significantly higher increase in weight during the first 15 weeks of life.

At all points in time the average length was lower in the LBW babies as compared to the NBW babies. However, the mean increment in length from birth to six months was significantly higher among the LBW babies than the NBW babies. The mean increments of length calculated by Paul B, *et al*⁵ in his study revealed that the LBW infants had higher increments as compared to that of NBW infants for each month except the 6th month. They concluded from their study that the LBW infants caught up in length by the 3rd month.

At all time periods, from birth to 6 months, the HC of LBW babies was significantly lower than the HC of NBW babies. We observed a lag in the increase of HC in the first month after which the mean increase in HC was higher among the LBW babies as compared to NBW babies. Paul B, *et al*⁵ found that 66.7% of the LBW babies caught up in HC at the 5th month. Gupta DN, *et al*⁸ found that SGA preterm infants showed complete HC catch-up growth by the age of 12 months, but mostly before 6 months after term (HC catch-up group).

Ehsanpour S, *et al*⁹ conducted a cross-sectional retrospective study on 214 neonates and their growth in the 2nd, 4th, 6th, 9th, 12th, 15th and 18th months was investigated. It was found that LBW infants had lower growth in weight, length and HC compared to normal birth weight infants. In a study by Sridhar K, *et al*², they observed that the rate of growth of LBW babies was slow initially and they would catch up to NBW babies by 1 year of life. Faisal M, *et al*¹⁰ concluded from their study that differences in height and weight between LBW children and NBW children decreased the most between 6 months and 3½ years.

There is a lack of understanding and clarity in the pattern of growth among the LBW babies as various studies have different conclusions. A study with a larger sample size including various geographical locations would be the way forward.

Conclusions

In this study LBW babies had a lag in the growth in the first month after which the rate of growth was significantly higher than in NBW babies.

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