Neurodevelopmental, Functional and Growth Status of Term Low Birth Weight Infants at Eighteen Months

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This study was done to evaluate the neurodevelopmental, functional and growth status of term infants weighing 2000 g or less at 18 months, and to analyze major medical and social factors associated with an adverse neurodevelopmental and/or functional outcome. All infants were assessed for growth, audio-visual, neurological impairment, and motor and mental development using Indian modification of Bayley Scales of infant development. A detailed history was also taken. Term infants with birth weight of >2500 g without any antenatal or neonatal complications served as controls. Fifty low birth weight (LBW) term infants and 30 controls were evaluated. The mean mental development Quotient for LBW infants [91.51(16.97)] was significantly lower than that of Controls [102.02(8.4)]; the mean motor development Quotient however was comparable. The LBW infants were significantly lagging in terms 'of weight, length and head circumference at assessment. Neonatal complications were associated with an abnormal motor outcome while lower Socio-economic status and maternal education were related to adverse mental status. We concluded that Term LBW infants are at a significant disadvantage in terms of growth and mental scores at 18 months.

Key words: *Low birth weight infants, Neurodevelopment status, Term.*

LOW Birth Weight (LBW) constitutes a major clinical and public health problem in developing countries, the incidence in India being reported to be around 33%(1). The subsequent development of these children is obviously of critical importance both to the future of the children and the individual nations. These LBW infants are a heterogeneous population and include both preterm and those born at term but small for gestational age (SGA).

Studies dealing with developmental outcome of LBW infants from west have dealt mostly with preterms and those from India have included a heterogeneous population of both preterms and term infants(2-4). Thus, the present study was designed to be carried out on term LBW infants weighing 2000 g or less at birth, evaluating their neurodevelopmental, functional and growth status at 18 months (± 2 months). The purpose of this study was also to identify the factors associated with an adverse motor and mental development, and impaired neurological status.

Subjects and Methods

This cross-sectional observational study was conducted at the 'Child Development and Early Intervention Clinic' in the Department of Pediatrics of a tertiary level teaching institution over a one-year period between April 2001 and March 2002. Infants born at term, in the hospital with a birth weight of < 2000 g were selected from the follow up of

the 'High-risk Clinic' at age 18 months (± 2 months) during the study period using computer generated random number table. A similar cohort of age matched term infants, with a normal antenatal, natal and postnatal course, and a birth weight >2500 grams were identified among the follow up of the 'Well Baby Clinic' of our hospital and enrolled as controls.

Gestational age assessment in these babies was based on the Ballard score(5) done within 24 hours of birth and last menstrual period. A gestational age of 37 to 42 weeks was taken to imply term gestation. Infants with gross congenital anomalies, obvious stigmata of chromosomal anomalies and infections of the CNS such as meningitis, encephalitis were excluded from the study.

A total of 50 cases and 30 controls were studied. The infants registered for the study were, with full parental consent, assessed for (*i*) Neurological impairment by the Amiel Tison method(6) (*ii*) Motor (DMoQ) and mental (DMeQ) development quotient on the Indian modification of the Bayley scales of Infant development(7), (*iii*) Growth in terms of weight, length and head circumference obtained by standard techniques and (*iv*) Hearing and visual impairments were assessed clinically and with electrodiagnostic procedures wherever appropriate. An ophthalmologist confirmed visual assessment. A detailed medical and social history including natal, prenatal, neonatal, post neonatal, family and socio-economic history was also taken. The socio-economic status was determined according to the Kuppuswamy(8) socio-economic status (SES) scale.

Statistical Analysis

The developmental outcome was compared between control and LBW infants. The data was analyzed for major medical and social factors associated with an adverse outcome. The continuous variables were evaluated by the use of 'student t-test' and proportions were analyzed by the use of 'Chi-square' test. A 'P' value < 0.05 was considered to be statistically significant.

Results

Baseline data of the study subjects is shown in *Table I*. Sixteen (32%) of the LBW had suffered neonatal complications including 8 with asymptomatic hypoglycemia, 3 with hypoglycemic seizures, 1 with hypocalcemic seizures and 2 infants with birth asphyxia. One child developed sepsis with recurrent apnoeas with encephalopathy, another had suffered from intracranial bleed due to alloimmune thrombocytopenia.

The two groups were assessed at similar age. During assessment, the LBW infants were significantly lighter (8.9 ± 1.5 kg vs 9.9 ± 1.5 kg, P = 0.007), shorter (74.4 ± 4.2 cm vs 77.6 ± 3.6 cm P <0.001) and had a smaller head circumference [45.0 ± 1.8 cm vs 45.9 ± 1.8, P = 0.025] as compared to the controls. The mean mental development quotient (DMeQ) for the LBW infants was within the normal limits but at a significantly lower level than that of the control group [91.5 ± 16.9 vs 102.0 ± 8.4; P = 0.002]. The mean motor development quotient (DMoQ) for the LBW infants [93.2 ± 19.7] was however comparable to that of the controls [99.5 ± 10.3](P = 0.09).

For the purpose of this study, a mental or motor quotient <85 was taken as adverse developmental outcome. Ten infants in LBW group and one in control group had lower mental score [odds ratio 7.25, 95% confidence interval 0.86, 159.7 (P = 0.05)]. Similarly, adverse motor outcome was seen in 12 LBW infants and one infant in control group, the difference was statistically significant [odds

ratio 9.16; 95% confidence interval 1.12, 199.25 (P = 0.03)]. On univariate analysis of factors associated with a poor outcome within the LBW group, only a lower socio-economic status and poorer maternal education were significantly related to poor mental performance (*Table II*). Seventy per cent of the children with an adverse outcome belonged to the SES categories III and IV. As depicted in *Table II* infants with an adverse outcome had a significantly lower weight, length and head circumference at assessment.

A DMoQ <85 was seen in 13 (16.2%) children, of which 12 were from the LBW group. The univariate analysis of characteristics of LBW infants (*Table III*) at birth again revealed no association between anthropometric parameters at birth and lower scores. Neonatal complications were significantly associated with adverse motor outcome. Once again, a lower weight, length and head circumference at assessment was associated with a poor motor outcome (P <0.001). Owing to the small numbers of infants with an adverse outcome, we could not subject the factors found significant on the univariate analysis to a multivariate analysis.

On neurological examination, two children from the study group and one among the controls were found to be impaired with disability.

The two children from the study group also had visual impairment. The first child had cortical blindness whilst the second child having suffered an intracranial hemorrhage at birth had an abnormal VEP of the left eye. No

TABLE I–*Baseline Characteristics of Infants.*

	LBW (n = 50)	Controls (n = 30)	P-value
Birth wt.(grams)*	1772.5(241.6)	2866.5 (241.9)	<0.001
Sex:	M	28(56%)	20 (66.7%) 0.346
	F	22(44%)	10 (33.3%)
Maternal age (yrs)*	25.3 (3.4)	24.6 (3.0)	0.348
Maternal education (yrs)*	8.9 (4.7)	9.4 (4.0)	0.630
Maternalparity*	1.8 (1.0)	1.9 (1.1)	0.719
Antenatal complications	29(58%)	0(0%)	<0.001
Socio-economic status			
	Class I	0 (0%)	1 (3.3%)
	Class II	29(58%)	18 (60%) 0.603
	Class III	6(32%)	8 (26%)
	Class IV	5(10%)	3 (10%)
Head circumference (cm)*	31.3 (1.6)	33.6(1.1)	<0.001
Length (cm)*	44.2 (2.2)	46.8 (2.0)	<0.001
PI* <2.24	41(82%)	0 (0%)	<0.001
Neonatal complications	16 (32%)	0 (0%)	<0.001

*Mean (standard deviation); Kuppuswamy's scale; Range (median).

TABLE II– *Univariate Analysis of Characteristics of LBW Infants Associated with an Adverse Outcome* on *the Mental Scale.*

	DmeQ ≤ 85 (n = 10)	DMeQ > 85 (n = 40)	P-value
Birth Wt. (Grams)*	1759.5(289.8)	1775.8(232.2)	0.851
Sex: M	4(40%)	24(60%)	0.43
F	6(60%)	16(40%)	
Head-circumference (cm)*	31.3(2.24)	31.3(1.4)	0.93
Length (cm)*	44.4(2.4)	44.2(2.2)	0.78
PI*	2.08(0.27)	2.16(0.28)	0.46
Neonatal complications	5(50%)	11 (27.5%)	0.32
Nursery Stay (Days)‡	3-16(7)	2-25(5)	0.14
Maternal age (yrs)*	24.4(3.5)	25.6(3.4)	0.33
Maternal edu. (yrs)‡	0-15(5)	0-17(10)	0.023
Maternal parity‡	1-4(2)	1-5(1)	0.09
Antenatal complications	4(40%)	25(62.5%)	0.35
Socio-economic status†			
Class I & II	3(30%)	26(65%)	0.05
Class III & IV	7(70%)	14(35%)	
Age (mths) *	18.4(1.4)	17.6(1.2)	0.07
Weight (kgs)*(at assessment)	7.4(1.4)	9.2(1.3)	<0.001
Head-circumference(cm) (at assessment)*	43.4(2)	45.4(1.6)	<0.001
Length (cm), (at assessment)*	70.7(4.5)	75.3(3.6)	0.001

* Mean (std. deviation); †Kuppuswamy's scale ; ‡Range (median)

child was found to have an impaired hearing clinically.

Discussion

It has been previously observed that the term LBW infants constitute the chief high-risk infant population in developing countries like ours(9). The growth and development of this exclusive group of infants has seldom been a subject of study of research groups from the wes(10). Studies from India too have mainly looked at the problems of a mixed cohort of preterm and term small for date babie(2,3). Hence, we chose to look at the growth, neurodevelopmental and functional status of term infants with a birth weight of < 2000 g at 18 months.

In this study, the LBW infants were significantly lagging behind in terms of all anthropometric parameters measured at 18 months. This is in keeping with previous studies(11-13). On developmental assessment; the LBW infants were functioning within the limits of normalcy. They were however at a small but significant disadvantage in terms of the average mental development though not for the motor field. Markestad, *et al.*(14) made similar observations in their evaluation of term SGA

TABLE III–*Univariate Analysis of Characteristics of LBW Infants Associated with an Adverse Outcome on the Motor Scale.*

	DNCQ < 85 (n = 12)	DMeQ > 85 (n = 38)	P-value
Birth Wt. (Grams)*	1722.1(259.4)	1788.4(237.2)	0.41
Sex: M	4(33.3%)	24(85.7%)	0.138
F	8(66.7%)	14(14.3%)	
Head-circumference (cm)*	31.1(2.0)	31.4(1.5)	0.58
Length (cm)*	44.2(2.2)	44.2(2.2)	0.92
PI*	2.1(0.3)	2.2(0.3)	0.58
Neonatal complications*	7(58.3%)	9(23.7%)	0.05
Nursery Stay (Days)‡	3-16(6)	2-25(4.5)	0.13
Maternal age (yrs)*	24.0(3.6)	25.8(3.3)	0.12
Maternal edu. (yrs)‡	0-15(7.5)	0-17(10)	0.12
Maternal parity‡	1-4(2)	1-5(1)	0.33
Antenatal complications	6(50%)	23(60.5%)	0.757
Socio-economic statust†			
Class I & II	6(50%)	23(60.5%)	0.757
Class III & IV	6(50%)	15(39.5%)	
Age (months)*	18.5(1.5)	17.5(1.1)	0.02
Weight (kgs)* (at assessment)	7.44(1.26)	9.3(1.3)	<0.001
Head-circumference(cm)*(at assessment)	43.5(1.9)	45.5(1.6)	0.001
Length (cm)*(at assessment)	70.8(4.5)	75.6(3.4)	<0.001

* Mean (std. deviation); †Kuppuswamy's scale ; ‡Range (median).

infants at 13 months. This is also in line with the observations of poorer IQ and school achievement in LBW infants at later ages of life(3).

An adverse developmental outcome was seen predominantly in the LBW group. On further analysis within the LBW group for possible associations, none could be established between the absolute birth weight, length or head circumference and an adverse developmental score. Studies in the past too have shown no correlation between the degree of IUGR / head circumference and outcome(15-17).

Neonatal complications can result in subtle and severe brain damage. Leitner, *et al.*(18) found the cumulative risk score to be most powerful in predicting the neuro-development at 6-7 years. In our study too we found a relation between neonatal complications and poor motor performance. This is one aspect that offers scope for improvement in the ultimate outcome of these infants. Another factor bearing influence on development is environment of a child. Lower maternal education and socio-economic status are indices of a poor rearing environment. These were associated with an adverse mental

Key Messages

- LBW infants (birth weight <2000 g) born at term are behind the controls (term with birth weight >2500 g) in all growth parameters.
- The mean developmental quotients of the LBW infants at 18 months were within limits of normal though the mental quotient was significantly lower than the controls.
- Lower socioeconomic status and maternal education were associated with an adverse mental outcome in the LBW infants.

outcome. Studies have shown that SGA infants from higher social classes score better on IQ tests than SGA from lower classes(19,20). Maternal education and the Bayley mental index were found to be related in the study of Markestad, *et al.*(14). Goldenberg, *et al.*(21) too demonstrated an association between maternal receptive level, positive home environment and IQ of term SGA infants. A study of LBW babies from India also found that maternal education had a strong impact on 6 year IQ(4). The risk of hearing, visual and neurological deficits among the LBW infants, especially in the absence of significant neonatal insults was low. Low, *et al.*(12) and Leitner, *et al.*(18) were also of the same opinion.

In summary, this small study suggests that being born LBW places one at a definite disadvantage for all growth parameters and to some extent for mental development. Also, the risk of a poor outcome in the LBW seems unrelated to the degree of growth retardation at birth. However, it is increased in a background of a poor socio-economic status and poor maternal education. Overall neurodevelop-mental outcome appears favourable especially if one can ensure an uncomplicated perinatal period. Studies on a larger scale are recommended to confirm the findings of our study.

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