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Clinical Evaluation On Term Low Birth Weight Infants For Neurodevelopmental Delay

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Abstract

Background: Low birth weight (LBW) in neonates is defined as a birth weight of less than 2500 g by the World Health Organization LBW classification is determined at birth and based on the absolute weight of the baby at birth regardless of gestational age. It is multifactorial and can be caused by preterm delivery or restricted fetal (intrauterine) growth. The latter can also result in the babies being small for gestational age (SGA), which is most commonly defined as a baby with a weight below the 10th percentile for the gestational age. Numerous studies have identified the factors, in addition to prematurity, that contributes to LBW including deprived socio-economic conditions of the mother (poor nutrition, poor access to care, high prevalence of infections, and high prevalence of pregnancy complications), and maternal health during pregnancy (nutrition, diet, use of alcohol/drugs/tobacco, infections and presence of hypertension and diabetes.

Aim Of The Study: To assess the neurodevelopmental outcome of term LBW infants using Trivandrum developmental Screening Test, Baroda developmental screening test, and Denver Developmental Screening Test – II.

Materials & Methods: this prospective study was conducted in government virudhunagar medical College & hospital, virudhunagar, from April 2021to June 2021 over 2 months. on term neonates with a gestational age of 37-42 weeks with a birth weight of less than 2.5kg. All neonates with a documented birth weight (Term, LBW) were identified in the outpatient clinic and enrolled in this study. The details regarding Birth weight, gestational age, Presence of antenatal illnesses, mode of presentation, and delivery were obtained by interviewing the mothers. The parents were informed regarding the neurodevelopmental assessment. The child's development was assessed by Trivandrum developmental screening test, Baroda developmental screening test, and Denver developmental screening test = II. In the analysis of neurodevelopmental outcome, we have grouped the test items of all three screening tests to compare the items passed or failed by the term low birth weight infants by those three screening tests, easily**.**

Results: Among the mothers with LBW babies, 34.66% had a normal antenatal period 41.33% had anemia, 7.33% had PIH, 2.66% had GDM, 14% had an infection, 22% had APH. Among the LBW who was followed by 78.66% had vertex presentation 21.33% had Breech presentation. BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 3 months of age. For the neurodevelopmental assessment at 9 months of age, there are 11 test items in Denver – II, there are 8 test items in the Baroda screening test, and 5 test items in Trivandrum developmental screening test. All the test items were passed by the 150 term LBW infants. Thus it indicates that all three screening tests are equally sensitive in identifying normal development among term LBW infants at 9 months of age. Adjusted OR of LBW for clinical diagnosis of 'neurodevelopmental delay' in the gross motor was 2.43 (95% CI 1.65 to

3.60), fine motor 1.49 (95% CI 1.01 to 2.19), and adaptability 1.56 (95% CI 1.06 to 2.31). LBW has no significant effects on 'neurodevelopmental delay' in language and social behavior, and macrosomia has no significant effects on clinical diagnosis of neurodevelopmental delay' in all domains.

Conclusion: All are equally sensitive and specific in identifying both normal developments as well as neurodevelopmental delay. Thus Trivandurm developmental screening test which has only 17 test items and requires only a Pen and a bunch of keys is equally sensitive and specific in identifying neurodevelopmental delay as well as normal development. So the busy Indian Pediatrician can use it in their outpatient clinic for neurodevelopmental assessment at least for the at-risk population for early detection of neurodevelopmental delay.

Keywords: Premature; Bayley-III; Infant, very low birth weight; Cohort studies; Longitudinal studies

Introduction

In an increasingly competitive world, it is essential to ensure that a child grows and develops to its full developmental potential. We are now in a position in our country to save the lives of several LBW, asphyxiated, and sick babies. As more of these babies survive, the chances of childhood developmental delay, speech problems, behavioral problems, attention deficit hyperkinetic disorder, and scholastic backwardness increases. If these children are followed up and problems in development are identified and treated early, these very children would be given a chance for optimum development. [1]This highlights the need for adopting early detection practices for developmental delay, subsequently leading to early intervention therapy. Another issue is the feasibility of technology necessary for the implementation of the above process. There are indeed many sophisticated, scientific methods for the assessment of development in children, but what we need is simple screening procedures that can be used in the community.[2]The pediatrician must play a pivotal role in identifying developmental disability since he is the one who gets uniquely involved in the care of the infant. Unfortunately in actual practice, it doesn't often happen. About 25 to 35 percent of babies in India are LBW as opposed to about 5 to 7 percent of newborns in the west. [3]The high Incidence of LBW babies in our country is accounted for by a higher number of babies with intrauterine growth retardation (small for dates) rather than preterm babies. The neurodevelopmental sequelae are more common in LBW babies compared to their normal-weight counterparts [4]

Materials & Methods

This prospective study was conducted in Government virudhunagar Medical College & Hospital, virudhunagar, from April 2021to June 2021 over 2 months. on term neonates with a gestational age of 37-42 weeks with a birth weight of less than 2.5kg. All neonates with a documented birth weight (Term, LBW) were identified in our patient clinic and enrolled in this study. The details regarding Birth weight, gestational age, Presence of antenatal illnesses, mode of presentation, and delivery were obtained by interviewing the mothers. The parents were informed regarding the neurodevelopmental assessment. The child's development was assessed by Trivandrum developmental screening test, Baroda developmental screening test, and Denver developmental screening test = II. In the analysis of neurodevelopmental outcome, we have grouped the test items of all three screening tests to compare the items passed or failed by the term low birth weight infants by those three screening tests, easily.

Exclusion Criteria: Preterm babies, Hypoxicischemicencephalopathy, Neonates with Sepsis (positive blood /CSF culture), Severely dysmorphic neonates with at least one major congenital anomaly, Neonates with Hepatosplenomegaly and cataract indicative of Intrauterine infection. Neonatal seizure / Jaundice requiring exchange transfusion Based on previous studies, the incidence of the neurodevelopmental outcome in neonates with LBW was expected to be about 30%. Using a 99% confidence interval the calculated sample size was 140. At the time of discharge from the hospital, babies were examined; weight, length, head circumference, and chest

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circumference were recorded for every newborn. The parents were counseled regarding the neurodevelopmental outcome of LBW and the need for follow-up and periodic developmental assessment. A Development assessment card was issued to every newborn, with details of follow-up dates. The infants were followed up at 3, 6, 9, 12, and 18 months of age. At each visit, the child's weight, length, head circumference, and chest circumference were noted. The child's development was assessed by Trivandrum developmental screening test, Baroda (Abbreviated Bayley scale of Infant development), and Denver Developmental Screening Test – II. A simple developmental screening test was designed and validated at the child development center, Trivandrum. There are 17 test items in the chart, carefully chosen after repeated trial and error. The age range for each test item is taken from the norms given in the Bayley scales of Infant development.

Baroda Developmental Screening Test: In BDST, the performance of the child was noted by plotting the total number of items passed by him/her (score) against the chronological age. The intersection of the horizontal level of this score with the 50% level curve indicated the developmental age of the child i.e. the age at 50% normal children are expected to have the same scale. The developmental quotient was calculated as follows: Developmental age / chronological age X 100. If the child's developmental Quotient was 77.5 (-1.5 SD) or less, the child was considered to have delayed development.

Denver Developmental Screening Test – II.Age range: 2 weeks to 6 years. This test was designed to be a quick and simple screening tool to be used in clinical settings by people with little training in developmental assessment. The test is comprised of 125 items, divided into four categories:1. Gross – motor 2. Fine motor / adaptive 3. Personal social 4. Language. The items are arranged in chronological order according to the ages at which most children pass them. The test is administered in 10-20 minutes and consists of asking the parent questions and having the child perform various tasks. The test kit contains a set of inexpensive materials. The test items are represented on the form by a bar that spans the age at which 25% 50% 75% and 90% of the standardization sample passed that item. The child's age is drawn as a vertical line on the chart and the examiner administers the items bisected by the line. The child's performance is rated pass, caution, or delay depending on where the age line is drawn across the bar. The number of delays or cautions is determined. the rating of Normal, Questionable, or abnormal. At the end of one and a half years, the neurodevelopmental outcome was analyzed and the results are as follows.

Results

Table :1 Demographic Details Of Lbw Infants

Sex	n	%
Male	**86**	**57.33**
Female	**64**	**42.66**

TABLE :1 SHOWS Among the LBW who were followed by 57.33% were males, 42.66% were females.

Table:2 Birth Weight Distribution Among Term Lbw Infants

Birth Weight	n	%
2 Kg – 2.5 Kg	98	65.33
1.5 Kg – 2.5 Kg	52	34.66
< 1.5 Kg	-	-

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TABLE:2 Among the term neonates who were followed by 65.33% were LBW with a birth weight of 2 Kg – 2.5 Kg, 34.66% were LBW with a birth weight of 1.5 Kg to 2 Kg.

Table :3 Demographic Details Of Lbw Infants Mothers:

Antenatal Illnesses	n	%
Anemia	62	41.33
PIH	11	7.33
GDM	4	2.66
Infection	21	14
APH	33	22
Nil	52	34.66

TABLE :3 Among the mothers with LBW babies, 34.66% had normal antenatal period 41.33% had anemia, 7.33% had PIH, 2.66% had GDM, 14% had an infection, 22% had APH

Table:4 Mode Of Presentation

Presentation	**n**	**%**
Vertex	118	78.66
Breech	32	21.33
Others	0	0

TABLE:4 Among the LBW who was followed by 78.66% had vertex presentation 21.33% had Breech presentation

Table:5 Mode Of Delivery:-

Mode of Delivery	**n**	**%**
Normal vaginal delivery	98	65.33
LSCS	52	34.66
Vacuum / Forceps	0	0

TABLE:5 Among the LBW who was followed by 65.33% had a normal vaginal delivery, 34.66% had LSCS

Table:6 Profile Of Developmental Delay – Assessment At 3 Months Of Age By Denver Ii, Baroda Screening Test, Tdst

Items	**Denver II**		**Baroda**		**TDST**	
	✓	□	✓	□	✓	□
A. GROSS MOTOR						
1. Equal Movements	150	-				

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2. Lift head	150	-				
3. Head up 45	150	-				
4. Head up 90	150	-				
5. Sit with head steady	150	-				
6. Arms & Legs thrust in play			150	-		
7. Lateral head movement			150	-		
8. Head erect and steady			150	-	150	-
B. LANGUAGE						
1. Respond to bell	150	-				
2. Vocalises	150	-				
3. Cooing	150	-				
4. Laughs	150	-				
5. Squeals	150	-				
6. Responds to sound			150	-		
C. FINE MOTOR						
1. Follow to Midline	150	-				
2. Follow past midline	150	-				
3. Grasp rattle	150	-				
4. Hands together	150	-				
5. Momentary regard			150	-		
6. Follows moving person			150	-		
7. Free Inspection of surrounding			150	-		

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8. Eye coordination			150	-		
9. Eyes follow the pencil					150	-
D. PERSONAL SOCIAL						
1. Regard face	150	-				
2. Smile responsively	150	-				
3. Smile spontaneously	150	-				
4. Regard own hands	150	-				
5. Social smile			150	-	150	-

TABLE:6 Comparison of Denver Developmental Screening test II and Baroda developmental screening test for neurodevelopmental assessment at 3 months of age

Table:7 Developmental Delay By DDST II

Developmental delay by BDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	0	0	0
No	0	150	150
	0	150	150

TABLE:7 BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 3 months of age.DST had a sensitivity of 100% specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 3 months of age. For the neurodevelopmental assessment at 3 months of age, there are 19 test items in Denver II, there are 9 test items in the Baroda screening test, and only 3 test items in Trivandrum developmental screening test. All the items were passed by the 150 term LBW infants. Thus it indicates that all three screening tests are equally sensitive in identifying normal development among term LBW Infants at 3 months of age.

Table:8 Profile Of Developmental Delay – Assessment At 6 Months Of Age By Denver Ii, Baroda Screening Test, Tdst

Items	Denver II		Baroda		TDST	
	✓		✓		✓	□
A. GROSS MOTOR						

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1. Bear weight on legs	150					
2. Chest up with arm support	150					
3. Rollover	150					
4. Pull to sit-no head lag	150					
5. Sit no support	150					
6. Holds head study			150	-		
7. Elevates on arms			150	-		
8. Sit with slight support			150	-		
9. Turn from back to the side			150	-		
10. Rolls from back to stomach					150	-
B. LANGUAGE						
1. Turn to rattling sound	150					
2. Turn to the voice	150					
3. Single syllable	150					
4. Imitate Speech	150					
5. Play with rattle			150	-		
6. Turns head to the sound			150	-		
7. Turn head to the sound of the bell					150	-
C. FINE MOTOR						
1. Follow 180	150					
2. Regards raisin	150	-				
3. Reaches	150	-				
4. Look for yarn	150	-				

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5. Breaks raisin	150	-				
6. Passes cube	150	-				
7. Reaches for dangling ring			150	-		
8. Objects hand to hand					150	-
D. PERSONAL SOCIAL						
1. Work for toys	150	-				
2. Feed Self	150	-				
3. Recognizes mother			150	-		
4. Exploitive paper play			150	-		

TABLE:8 Comparison of Denver developmental screening test II and Trivandrum developmental screening test for neurodevelopmental assessment at 6 months of age

Table:9 Profile Of Developmental Delay – Assessment At 9 Months Of Age By Denver Ii, Baroda Screening Test, Tdst

	Denver II		**Baroda**		**TDST**	
Items	**✓**	**r**	**✓**	**r**	**✓**	**r**
A. GROSS MOTOR						
1. Stand holding on	150	-				
2. Pull to stand	150	-				
3. Get to sitting	150	-				
4. Pull to sit			150	-		
5. Sits alone steadily			150	-		
6. Pulls to stand			150	-		

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7. Sits with good coordination			150	-		
8. Raises self to sit position					150	-
9. Standing up by furniture					150	-
10. Walk with help					150	-
B. LANGUAGE						
1. Dada – mama non specific	150	-				
2. Combine syllables	150	-				
3. Blabbering	150	-				
C. FINE MOTOR						
1. Take 2 cubes	150	-				
2. Thumb finger grasp	150	-				

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3. Bang 2 cubes held in hands	150	-				
4. Bangs in play			150	-		
5. Retails 2 things in hands			150	-		
6. Fine prehension pellet					150	-
D. PERSONAL SOCIAL						
1. Play pat a cake	150	-				
2. Imitate wants	150	-				
3. Discriminates strangers			150	-		
4. Playful response to mirror image			150	-		
5. Pat a cake					150	-

TABLE:9 BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 9 months of age. For the neurodevelopmental assessment at 9 months of age, there are 11 test items in Denver – II, there are 8 test items in the Baroda screening test, and 5 test items in Trivandrum developmental screening test. All the test items were passed by the 150 term LBW infants. Thus it indicates that all three screening tests are equally sensitive in identifying normal development among term LBW infants at 9 months of age.

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Table:10 Profile Of Developmental Delay – Assessment At 1 Year Of Age By Denver Ii, Baroda Screening Test, Tdst

Items	Denver II		Baroda		TDST	
	✓	□	✓	□	✓	□
A. GROSS MOTOR						
1. Stand 2 Sec	150	-				
2. Standalone	150	-				
3. Stoop and recover	150	-				
4. Crawling			150	-		
5. Raises to sit			150	-		
6. Stands by furniture			150	-		
7. Walks alone					150	-
B. LANGUAGE						
1. Dada mama specific one word	150	-				
2. Two word	150	-				
3. Adjusts to words			150	-		
4. Says dada			150	-		
C. FINE MOTOR						
1. Put block in cup	150	-				
2. Pulls string secures toy			150	-		
3. Fine prehension			150	-		
D. PERSONAL SOCIAL						
1. Waves byebye	150	-				
2. Play ball with the examiner	150	-				

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3. Cooperates in play			150	-		
4. Rings bell purposefully			150	-		
5. Throws ball					150	-

TABLE;11 BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 12 months of age. For the neurodevelopmental assessment at one year of age, there are 8 test items in Denver – II, there are 9 test items in the Baroda screening test, and 2 test items in Trivandrum developmental screening test. All the test items were passed by the 150 term LBW infants. Thus it indicates that all three screening tests are equally sensitive in identifying normal development among term LBW infants at one year of age.

Table:12 Profile Of Developmental Delay – Assessment At 18 Months Of Age By Denver Ii, Baroda Screening Test, Tdst

Items	Denver II		Baroda		TDST	
	✓	□	✓	□	✓	□
A. GROSS MOTOR						
1. Walk well	150	-				
2. Walk backward	150	-				
3. Run	150	-				
4. Walk upstairs	150	-				
5. Walk with help			150	-		
6. Stands alone			150	-		
7. Walks alone			150	-		
8. Walk backward					150	-
9. Walk upstairs with the help					150	-
B. LANGUAGE						
1. Three Words	150	-				
2. Six Words	150	-				
3. Imitates words			150	-		

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4. Says two words					150	-
C. FINE MOTOR						
1. Scribble	150	-				
2. Dump raisin demonstrated	150	-				
3. Midlines skills			150	-		
4. Turns pages			150	-		
5. Spontaneous scribble			150	-		
D. PERSONAL SOCIAL						
1. Imitate activities	150	-				
2. Drink from the cup	150	-				
3. Help in the house	150	-				
4. Use a spoon or fork	150	-				
5. Remove garments	150	-				
6. Inhinits on commands			150	-		
7. Throws ball			150	-		
8. Gestures for wants			150	-		

TABLE:13 BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 18 months of age. Comparison of Denver developmental screening test II and Trivandrum developmental screening test for neurodevelopmental assessment at 18 months of age.TDST had a sensitivity of 100% specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 18 months of age. For the neurodevelopmental assessment at one and a half years of age, there are 13 test items in Denver – II, there are 10 test items in the Baroda screening test, and 3 test items in Trivandrum developmental screening test. All the test items were passed by the 150 term LBW infants. Thus it indicates that all three screening tests are equally sensitive in identifying normal development among term LBW infants at one and a half years of age.

Discussion

The incidence of low birth weight is reported to be much higher in developing countries. About 25 to 35 percent of babies in India are LBW as opposed to about 5 to 7 percent of a newborn in the developed country. In India alone, 6 to 8 million LBW infants are born annually and present a formidable challenge to health professionals from the point of view of preventive as well as therapeutic interventions.The neurodevelopmental sequelae are more common in LBW babies compared to their normal-weight counterparts.Very often, their problems are identified quite late, maybe at school age when only some

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rehabilitation measures can betake several studies have shown that early intervention is effective in improving the developmental status. [5] A study conducted by the Department of Pediatric Neurology, the University of Heidelberg on 70 Low-risk birth weight children without neurological impairment, which was a follow-up study from birth to 7 years of age showed that there was an increased frequency of moderately subnormal test results (Developmental Quotient) among low birth weight infants. Even for the slightly LBW group (2000 to 2499 g), poorer language abilities were confirmed. So, In their study, they have concluded that all LBW infants including Low-risk populations, should be included in a follow-up program to detect deficits early in life and begin treatment before school entry.A study on Neurodevelopmental, Functional, and growth status of term LBW infants at 18 months of age was conducted by the Department of Pediatrics, Maulana Azad Medical College and Associated Lok Nayak Hospital, New Delhi. This study was done to evaluate the Neurodevelopmental functional and growth status of term infants weighing 2 Kg or less 18 months, and to analyze major medical and social factors associated with an adverse neurodevelopmental and functional outcome. All infants were assessed for growth, audiovisual, neurological impairment, and motor and mental development using Baroda developmental screening test.Term infants with a birth weight of > 2.5 Kg without any Antenatal (or) neonatal complications served as control. 50 LBW term infants and 30 controls were evaluated. The mean Developmental Quotient for LBW infants [91.51 (16.97)] was significantly lower than that of control [102.02(8.4)]. [6] Neonatal complications were associated with an abnormal motor outcome. They concluded that term LBW infants are at a significant disadvantage in terms of growth and mental scores at 18 months of age. In our study, we followed term LBW infants without any neonatal complications over 18 months, since the previous study showed that term LBW infants are at a significant disadvantage in terms of growth and mental scores at 18 months of age. In our study, we also analyzed the effects of risk factors in terms of Antenatal illnesses such as Hypertension, Diabetes mellitus, Infection, etc., on LBW and their neurodevelopmental outcome. A retrospective cohort study conducted by the Mississippi department of health showed that maternal chronic Hypertension, Diabetes, and cardiac disease were significantly associated with LBW among African Americans.A population-based long term follow-up study of 130 LBW infants published in Acta paediatrica (volume 95 Issue) showed that maternal chorioamnionitis, known to be associated with an increased frequency of cerebral palsy, may have lasting negative consequences for fetal brain development, resulting in long-term cognitive impairment.In the present study, the developmental assessment was done by three standard screening tests:-Denver developmental screening test II, Baroda developmental screening test.[7] Trivandrum developmental screening test. To the best of our knowledge, there are no articles published in English literature regarding the neurodevelopmental assessment among term Low birth weight infants without any neonatal complications by using these three screening tests. Therefore we were unable to compare our results with similar studies.This study has also compared the results of those three screening tests. No previous studies are comparing these 3 Scales in assessing the neurodevelopmental outcome among term LBW infants. Thus we couldn't compare our results with similar studies.According to this present study, all three screening tests are equally sensitive and specific in identifying both normal developments as well as delays among term LBW infants.[8]In a recent internet study, under the aegis pediatric education and communication network (PECN), 72 % European, 70% American and only 20% Indian Pediatrician said, they were routinely carrying out some form of developmental screening in their general practice. The result of our study showed that the Trivandrum developmental screening test, a simple developmental screening test that has 17 test items and requires only a pen and a bunch of keys are equally sensitive and specific in identifying neurodevelopmental delay as well as normal development compared to Denver developmental screening test II which has 125 items and four domains.[9] Hence, from our study, it was concluded that Trivandrum developmental screening test can be used by the busy Indian pediatrician in their outpatient clinic for neurodevelopmental assessment.[10]

Conclusion

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Thus our study signifies the importance of periodic neurodevelopmental assessment of at-risk population, Low birth weight infants, for early detection of neurodevelopmental delay. For neurodevelopmental assessment at 18 months of age: All are equally sensitive and specific in identifying both normal developments as well as neurodevelopmental delay. Thus Trivandurm developmental screening test which has only 17 test items and requires only a Pen and a bunch of keys is equally sensitive and specific in identifying neurodevelopmental delay as well as normal development. So the busy Indian Pediatrician can use it in their outpatient clinic for neurodevelopmental assessment at least for the at-risk population for early detection of neurodevelopmental delay.

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