RESEARCH ARTICLE

DEVELOPMENTAL STATUS OF NICU ADMITTED LOW BIRTH WEIGHT PRETERM NEONATES AT 6 AND 12 MONTHS OF AGE USING AGES AND STAGES QUESTIONNAIRE

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Abstract

Objective

Low birth weight (LBW or birth weight<2500g) can be one of the serious problems in children. The purpose of this study was to evaluate the developmental status of LBW preterm neonates admited at neonatal intensive care unit (NICU) at the corrected ages of six and 12 months via the Persian version of Ages and Stages Questionnaires (ASQ).

Materials & Methods

In a follow up study, fifty LBW preterm neonates admitted to Shahid Sadoughi Hospital NICU in 2008 were evaluated for developmental status at 6 and 12 months of age using ASQ.

Results

Twenty four boys and 26 girls with a mean gestational age of 31.3 ± 2.7 weeks and a mean birth weight of 1480.3 ± 422.8 grams were evaluated. Developmental delay in gross motor and personal social skills domains were the most prevalent abnormal developmental status at 6 and 12 months of age. Mean score in gross motor skills, personal social skills and problem solving domains at 12 months of age were significantly higher in neonates with birth weight ≥ 1500 grams.

Mean score in fine motor skills, communication and problem solving domains at 12 months of age were significantly higher in neonates who were exclusively breast fed.

Conclusion

LBW and preterm infants admitted to the NICU showed degrees of developmental delay at the ages of 6 and 12 months, especially in the gross motor and personal-social developmental domains on the ASQ. So, evaluation and monitoring of development status of LBW should be emphasized for early and timely diagnosis, investigation, and management.

Keywords: Low birth weight; developmental delay; ages and stages questionnaires (ASQ); NICU; preterm.

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Introduction

Low Birth Weight (LBW as birth weight less than 2500 grams) is one of the major causes of neonatal and postnatal morbidity. LBW neonates are subgrouped according to the first weight determination after birth as:
Moderately Low Birth Weight (MLBW): between 1500 and 2499 grams

Very Low Birth Weight (VLBW): less than 1500 grams Extremely Low Birth Weight (ELBW): less than 1000 grams. Cerebral palsy, mental retardation and other sensory and cognitive dysfunctions are higher in LBW infants than in infants with normal birth weight (birth weight 2500- 4000 g or NBW) (1).

According to WHO statistics, the rate of LBW is 17% in the worldwide (6% in industrialized countries and 21% in developing countries). Based on the results of two studies, the rate of LBW is 10% in the Islamic Republic of Iran (2) and 8.4 % in Yazd (the central city of Iran) (3).

On the other hand, almost 16 percent of children have a developmental disorder (4). Based on recommendations of the American Academy of Pediatrics for early diagnosis of neurodevelopmental delay, developmental surveillance should be performed in all infants and young children at every well-child visit and formal standardized screening tools must be used at selected age intervals (9, 18, and 24 or 30 months) if there is developmental concerns by the parent or the provider during surveillance (5). Developmental screening tests may be used by trained professionals (Denver II, the Bayley Neurodevelopmental screener, the Batelle Developmental Inventory,etc) or by the parents [Ages and Stages Questionnaires (ASQ), Parents' Evaluation of Developmental Status, Minnesota Child Development Inventory, Kent Inventory of Developmental Skills, Parent Report of Children's Abilities Revised for Preterm Infants].

Parental reports screening tests are cost- effective, easy to complete, time saving and terminate the challenge of directly extracting skills from children who, by reasons such as illness, sleepiness, anxiety and fear, may not show their best effort on the testing day and it also can not detect true problems (6,7). Amongst the tests, ASQ is currently the most widely used. Based on the results of other studies, sensitivity of ASQ test is 75% in high risk group and 100% in the community groups, with a specificity of 95% and 90%, respectively. The validity of this test varies from 76% to 88% (8-13).

The purpose of this study was to evaluate the developmental status of NICU admitted LBW preterm neonates at the corrected ages of 6 and 12 months via the Persian version of the six and 12 -months ASQ in Yazd, the central city of Iran.

Materials & Methods

The sample size based on Z formula and a confidence interval of 95% with 80% power to detect a significant difference between the two groups with a level of 0.05 was calculated to be 50 children. Gestational age less than 37 weeks was considered as preterm neonate (1).

In a follow up prospective study, all consecutive preterm LBW neonates admitted to Shaheed Sadoughi Hospital NICU in 2008, entered the study until the desirable sample size was completed. In NICU admission period, researchers interviewed patients' parents with emphasis on growth and developmental assessment of preterm LBW infants for early detection of developmental delay. Then, these infants were followed up for one year and their developmental status at the corrected ages of 6 and 12 months was evaluated via the Persian version of Ages and Stages Questionnaires (ASQ).

We had the standard ASQ translated and standardized for Iranian children by Health Office, Health Deputy of Ministry of Health and Medical Education of Iran.

Multiple pregnancies, severe asphyxia, children with major congenital malformations, small for gestational age (SGA), chromosomal abnormalities and genetic syndromes were excluded.

Then, the developmental status of these children was assessed using the Persian version of ASQ at 6 and 12 months after interview with parents in all cases.

Corrected age was calculated by subtracting gestational age from 37 weeks and the result was subtracted from chronological age: (37 – gestational age = A, Corrected age = Chronological age - A)

ASQ includes 19 different questionnaires that can screen developmental status of the children from 4 to 60 months in five different domains: communication, gross motor, fine motor, problem solving and personal social skills. Each domain is evaluated by six questions regarding what the child can or cannot do. They are selected so as to be representatives of a developmental quotient of 75–100%. The answer of parents to each question is "yes" to indicate that the child does the specific behavior of this item, ''sometimes'' to indicate an occasional or emerging response and ''not yet'' to indicate that their child does not yet do the behavior, with a respective

score of 10, 5 or 0 points. Then, scores of each item are summed and the final score in each domain is compared with cut-off points of the ASQ guidelines. The score on any domain below the cut-off point or higher than two standard deviations below the mean of the reference group is considered abnormal and referred for further evaluation (9 - 14).

The same children were evaluated at six months and followed up to 12 months, and their developmental status was evaluated again at 12 months.

Scores in each item were compared with Iranian cut-off points and the score of each domain below the cut-off point was considered as developmental delay in this domain.

The data were analyzed using SPSS 15 statistical software. Chi-square test or Fisher exact test were used for data analysis of qualitative variables and mean values were compared using independent T-test. Differences were considered significant at P values of less than 0.05.

This study was approved by the Ethic Committee of Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

Results

One girl died at four months and one boy died at 9 months; therefore, they were excluded from the study. Parents of five infants did not return for follow up and therefore their infants were excluded from study. Finally, 24 boys (48%) and 26 girls (52%) with a mean gestational age of 31.3 ± 2.7 weeks (range = 26 -37 weeks) and a mean birth weight of 1480.3 ± 422.8 grams (range = 700 -2300 grams) were evaluated.

Frequency of developmental delay in each developmental domain (in percent) is shown in Table 1 indicating that abnormal developmental status in gross motor and personal social skills domains were the most prevalent at six and 12 months.

Frequency of developmental delay in each developmental domain based on sex is presented in Table 2, showing that sex distribution was not different.

Table 3 shows comparison of the frequency of developmental delay in each developmental domain based on birth weight demonstrating no statistically significant difference. Comparison of mean scores in all developmental domains based on birth weight is presented in Table 4. T- test showed that mean score in gross motor, personal social skills and problem solving domains at 12 months of age were significantly higher in neonates with a birth weight equal to or more than 1500 grams.

Comparison of the frequency of developmental delay in each developmental domain based on nutritional style did not show any significant differences. However, comparison of mean scores in each developmental domain based on nutritional style (Table 5) showed that mean score in fine motor, communication and problem solving domains at 12 months of age were significantly higher in neonates who were exclusively breast fed.

Table1: Frequency of developmental delay in each developmental domain

Developmental domain	At the age of six months					At the age of 12 months				
	Normal		Delay		Total	Normal		Delay		Total
	Number	Percent	Number	Percent		Number	Percent	Number	Percent	
Gross motor	33	66	17	34	50	37	74	13	26	50
Fine motor	43	86	7	14	50	48	96	2	4	50
Personal social	39	78	11	22	50	40	80	10	20	50
Problem solving	47	94	3	6	50	48	96	2	4	50
Communication	47	64	3	6	50	47	94	3	6	50

Table 2: Frequency of developmental delay in each developmental domain based on sex

Developmental domain		At the age of six months						At the age of 12 months					
		Female		Male		Total	P. Value	Female		Male		Total	P. Value
		No.	percent	No.	percent			No.	percent	No.	percent		
Gross motor	Normal	15	57.6	18	75	33	0.19	19	73	18	75	37	0.87
	Delay	11	42.4	6	25	17		7	27	6	25	13	
Fine motor	Normal	24	92.3	19	79	43	0.18	24	92.3	24	100	48	0.16
	Delay	2	7.7	5	21	7		2	7.7	0	0	2	
Problem solving	Normal	24	92.3	23	96	47	0.6	25	96	23	96	48	095
	Delay	2	7.7	1	4	3		1	4	1	4	2	
Personal social	Normal	22	84.6	17	71	39	0.24	21	80.7	19	79	40	0.88
	Delay	4	15.4	7	29	11		5	19.3	5	21	10	
Communication	Normal	25	96	22	91.6	47	0.5	25	96	22	91.6	47	0.5
	Delay	1	4	2	8.4	3		1	4	2	8.4	3	

Table 3: Frequency of developmental delay in each developmental domain based on birth weight

Developmental domain		At the age of six months						At the age of 12 months					
		<1500 grams		≥1500 grams		Total	P. Value	<1500 grams		≥1500 grams		Total	P. Value
		No.	percent	No.	percent			No.	percent	No.	percent		
Gross motor	Normal	14	61	19	70	33	0.34	16	69.5	22	81	37	0.41
	Delay	9	39	8	30	17		7	30.5	5	19	13	
Fine motor	Normal	19	82.6	24	88.8	43	0.9	22	95.6	26	96	48	0.82
	Delay	4	27.4	3	21.2	7		1	4.4	1	4	2	
Problem solving	Normal	21	91	26	96	47	0.84	21	91	27	100	48	0.67
	Delay	2	9	1	4	3		2	9	0	0	2	
Personal social	Normal	17	80	22	81	39	0.94	18	78	22	81	40	0. 48
	Delay	6	20	5	19	11		5	22	5	19	10	
Communication	Normal	21	91	26	96	47	0.76	21	91	26	96	47	0.56
	Delay	2	9	1	4	3		2	9	1	4	3	

Table 4: Comparison of mean scores in each developmental domain based on birth weight

Birth weight / Developmental domain	<1500 grams Mean ± SD		≥1500 grams Mean ± SD		P.value	
	6 months	12 months	6 months	12 months	6 months	12 months
Gross motor	38.3 ± 19.3	42.6 ± 18.1	43.1 ± 12.3	51.3 ± 9.7	0.52	0.02
Fine motor	48.7 ± 13.3	52.8 ± 10.7	51.6 ± 11.2	56.9 ± 6.8	0.54	0.11
Problem solving	54.1 ± 10.2	54.8 ± 8.5	54.6 ± 9.3	59.1 ± 2.8	0.91	0.04
Personal-social skills	43.5 ± 19.4	47.8 ± 15.6	46.4 ± 13.1	55.4 ± 6.9	0.9	0.02
Communication	51.1 ± 10.4	53.1 ± 8.6	55.2 ± 7.9	56.5 ± 6.5	0.16	0.12

Table 5: Comparison of mean scores in each developmental domain based on nutrition

Nutrition / Developmental domain	Breast milk Mean ± SD		Formula Mean ± SD		Mixed Mean ± SD		P. value	
	6 months	12 months	6 months	12 months	6 months	12 months	6 months	12 months
Gross motor	43.9 ± 15.5	48.6 ± 14.5	39.6 ± 17.6	46.3 ± 15.9	39.3 ± 16.2	46.2 ± 15.5	0.65	0.91
Fine motor	52.5 ± 9.6	57.8 ± 5.8	46.5 ± 14.8	50.8 ± 9.7	51.1 ± 11.9	55.2 ± 10.2	0.66	0.04
Problem solving	55.1 ± 9.4	57.8 ± 5.8	51.5 ± 13.4	55.1 ± 10	55.7 ± 6.7	57.5 ± 4.4	0.78	0.73
Personal-social	46.4 ± 14.6	56.4 ± 6.33	41.1 ± 17.1	45.8 ± 14.9	46.5 ± 17.5	51.7 ± 13.3	0.56	0.04
Communication	56.7 ± 6.7	59.2 ± 2.7	50.7 ± 11.8	51.2 ± 10.5	52.1 ± 8.8	53.7 ± 7.1	0.17	0.02

Discussion

Low birth weight and preterm infants admitted to the NICU showed degrees of developmental delay at ages of 6 and 12 months, especially in gross motor and personal-social developmental domains, on the ASQ screening test.

In a study by Zhang et al in Shanghai, China, on preterm infants discharged from NICU at the age of one year, critical and abnormal neurological development were seen in 29.0% and 12.4% of them respectively and prematurity, low education level of parents, multiple pregnancies, severe intracranial hemorrhage and apnea were risk factors of developmental delay (15).

In this study, 34% of LBW neonates had gross motor delay at the age of one year. In a Spanish study, developmental outcome of 116 extremely low birth weight infants during the first three years of life was assessed, demonstrating cerebral palsy in 50% of them while psychomotor and speech development was normal in most of these children (16).

Two other studies showed that prematurity and VLBW were accompanied by significant motor impairment at the age of seven year (17) which persisted throughout childhood (18).

In a study in Germany, development status of 65 low-risk LBW preterm infants from childhood to late adolescence was compared to 41 term born controls. School enrollment of the LBW was mostly delayed, and lower school graduation was more frequently seen in them. In general, LBW children showed no main deficits in late adolescence but subtle neurodevelopmental deficits were observed in them (19).

In a study by Datar, mental and motor development of VLBW and MLBW babies during the first two years of

life was compared with those of normal birth weight ones. LBW had a small adverse effect on mental and motor development in the first two years of life (20).

In the present study, infants who were exclusively breast fed for six months had higher mean scores in fine motor, communication and problem solving domains at the age of one year which was in compliance with other studies (21-23) showing the beneficial effects of breastfeeding on the development of cognitive function of children, especially LBW newborns. Breast feeding for less than 6 months increases behavioral problems and may be a predictor of adverse mental health outcome throughout childhood and early adolescence (24).

In the present study, frequency of developmental delay in each developmental domain was not different in both sexes which is consistent with other studies (15-18).

We noted that the frequency of developmental delay in each developmental domain (except for communication) decreased from six to 12 months.

In a study by Grantham et al in northeast Brazil, mental and psychomotor development of term LBW and NBW infants was assessed with the Bayley Scales at 6 and 12 months of age. LBW infants had significantly lower scores in mental development and psychomotor development index at 6 months of age. The difference in both these scores increased by 12 months of age (25).

In a study in Madura, Indonesia, motor development of LBW and NBW babies was assessed. There was no difference in motor development between LBW and NBW infants in the first 6 months (26).

One possible explanation for this discrepancy is difference in race, study design and sample size. On the other hand, many surviving LBW infants have hypotonia before corrected age of eight months which improves by the time they are 8 months to one year old, and this transient hypotonia is not a sign of poor prognosis (27).

One of the limitations of the present study was its small sample size, and another limitation was the lack of a control group. Therefore, it is suggested that further studies be conducted with a larger sample sizes and a control group (normal birth weight infants) for comparison.

It should be mentioned that ASQ is one of developmental screening tests whose results are not absolute and children with scores below the cut-off point or higher than two standard deviations below the mean of the reference group on any domain must be referred for further evaluation by diagnostic tests and investigations (9-14).

In conclusion, developmental assessment is necessary in low birth weight infants and accurate recording of development status by the staff of health centers, regular and frequent visiting of these children, education of their parents regarding development process, follow up and encouraging exclusive breastfeeding should also be emphasized for early and timely diagnosis, investigation, management. Identifying children with possible developmental delays at the beginning of formal schooling, instead of waiting for harsh problems which may arise later on, can prevent from different problems for them and their parents.

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