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Original Article

Developmental Outcomes of Premature and Low Birth Weight Infants

Reza Saeidi[1], Shaghayegh Rahmani[2*], Ashraf mohammadzadeh[3], Ahmad shah farhat[4], Maryam Saeidi[5], Alireza ataei[6]

1. Associate Professor of Neonatology, Neonatal Research Center, Imam Reza Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
2. General physician, Patient safety research center, Mashhad University of Medical Sciences, Mashhad, Iran
3. Professor of Neonatology, Neonatal Research Center, Imam Reza Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
4. Assistant Professor of Neonatology, Neonatal Research Center, Imam Reza Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
5. BSc in Midwifery, Mashhad University of Medical Sciences, Mashhad, Iran
6. Assistant Professor of pediatrics, Imam Reza Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

ABSTRACT

***Background*:** Prematurity is the most common cause of death and disability And Preterm infants, are prone to developmental complications. For this reason this study was designed for follow up of these babies until 2 years by modified DDST-2.

***Methods*:** This study was a prospective longitudinal descriptive study from March 2009 to March 2011 in clinic of sheikh and Imam Reza Hospitals, Mashhad, Iran. Sample size with Confidence coefficient of 95% and power 80%, was determined 100 hundred babies. Infants were seen by a pediatrician at a follow up clinic at 1, 3, 6, 9,12,15,18, 24, months. The developmental assessment was done using Denver-2 Developmental Screening Test.

***Results*:** mean age for smiling was 4.6 ± 2.1 months which significantly differed with appropriate age ($p<0.001$), mean age for telling two syllables words 11.7 ± 1.9 months, without significant difference of appropriate age.($p = 0.139$). Average age for understanding NO was 10.4 ±2.0 months that significantly differed with appropriate age ($p<0.001$). The average age for telling 6 word was 17.8 ±3.0, without significant difference with appropriate age ($p = 0.510$).

Conclusion: Children with history of prematurity and low birth weight have more disability and developmental delay so they need to developmental screening tests.

Keywords: low Birth Weight, Prematurity, developmental delay

Introduction

Prematurity is the most common cause of death among infants worldwide. [1]And Preterm infants, are prone to developmental complications in comparison to term infants. [2-4]

About 15 million babies are preterm each year (5% to 18% of all deliveries). In many countries rates of premature births have increased between the 1990s and 2010s. [3]

It is estimated that at least 75% of preterm infants would survive with appropriate treatment. [3]

The chance of survival is about zero at less than 23 weeks, 15% at 23 weeks, 55% at 24 weeks % and 80% at 25 weeks. [5]

Worldwide, prematurity accounts for 10% of neonatal mortality, or around 500,000 deaths per year. [6]While In the U.S. prematurity is cause of 25% of neonatal mortality because other causes of neonatal death have been markedly reduced, [7]

Preterm infants are at risk for numerous medical problems like cerebral palsy, delays in development, hearing and visual problems. [1]

Probably White matter brain abnormality is cause of cognitive dysfunction. [8] White matter connectivity between the frontal and posterior brain regions is critical in learning to identify patterns in language. [9]

A study of 241 children born between 22 and 25 weeks who were currently at school age found that 46 percent had severe or moderate disabilities such as cerebral palsy, vision, hearing or learning problems. 34 percent were mildly disabled and 20 percent had no disabilities, while 12 percent had disabling cerebral palsy. [10, 11]

Finally Preterm birth is a significant cost factor in healthcare and preterm babies more likely need to services by physical therapists, occupational therapists, or speech therapists. [12]

* *Corresponding author*: Shaghayegh Rahmani, General physician, Patient safety research center, Mashhad University of Medical Sciences, Mashhad, Iran. Tel: Email: Rahmanish3@mums.ac.ir

A 2003 study in the US determined neonatal costs to be $224,400 for a newborn at 500–700 g versus $1,000 at over 3,000 g. The costs increase exponentially with decreasing gestational age and weight. [13]

The 2007 Institute of Medicine report *Preterm Birth* found that the 550,000 preemies born each year in the U.S. run up about $26 billion in annual costs, mostly related to care in NICUs, but the real tab may top $50 billion. [14]

Due to the importance of long term problems of premature infants, this study was designed for follow up of these babies until 2 years by modified DDST-2.

Methods

This study was a prospective longitudinal descriptive study from March 2009 to March 2011 in clinic of sheikh and Imam Reza Hospitals, Mashhad, Iran.

The method of sampling was non-competitive and based on aim.

Sample size with Confidence coefficient of 95% and power 80%, was determined 100 hundred babies.

In our study all premature and LBW infants born between March 2009 and March 2011 treated at the NICU of Imam Reza Hospital who survived to discharge were invited to participate in the follow up study.

The following infants were excluded: the babies with congenital anomalies, IUGR/ SGA, LGA, and those would not be available for follow up and those whose parents refused consent.

The study was approved by the Ethics Committee of Mashhad University of Medical Science.

Infants were seen by a pediatrician at a follow up clinic at 1, 3, 6, 9,12,15,18 and 24 months.

Children with health and/or developmental problems were followed up for longer and referred to appropriate specialist clinics as needed.

The developmental assessment was done using Denver-2 Developmental Screening Test.

The Denver Developmental Screening Test (DDST) is a test for screening cognitive and behavioral problems in preschool children. It was developed by William K. Frankenburg and first introduced by him and Josiah.B. Dobbs in 1967. [15]

The scale reflects what percentage of a certain age group is able to perform a certain task.

Tasks are grouped into four categories (social contact, fine motor skill, language, and gross motor skill) and include items such as *smiles spontaneously* (performed by 90% of three-month-olds), *knocks two building blocks against each other* (90% of 13-month-olds),speaks three words other than "mom" and "dad" (90% of 21-month-olds), or *hops on one leg* (90% of 5-year-olds).

According to a study commissioned by the Public Health Agency of Canada, the DDST is the most widely used test for screening developmental problems in children. [16]

But the test has been criticized to be unreliable in predicting less severe or specific problems.

The Denver II (1992) is a revision and update of the Denver Developmental Screening Test, DDST (1967). Both were designed for use by the clinician, teacher, or other early childhood professional to monitor the development of infants and preschool-aged children.

The DENVER II, published in 1992, was standardized on 2,096 children.

In this study we designed a questionnaire in accordance with the criteria of DENVER II.

Content validity was confirmed by four professors of Mashhad University of Medical Sciences and reliability was approved equivalent.

The data were analyzed by Spss11.5 and One sample test.

Results

We evaluated 100 premature and LBW infants who survived and discharge from NICU. From all babies; 48% (48 cases) were males and 52% (n = 52) female. Maternal age was between 17 – 40 years with average of 25.1 ± 7 years. There were 4% (4 cases), maternal history of abortion and 7% (7%) history of intrauterine fetal death.

We found 37% (37 children) history of hospitalization due to complications of neonatal period.

mean age for smiling was 4.6 ± 2.1 months which significantly differed with appropriate age ($p<0.001$), mean age for telling two syllables words 11.7 ± 1.9 months, without significant difference of appropriate age.($p = 0.139$).

Average age for understanding NO was10.4 ± 2.0 months that significantly differed with appropriate age ($p<0.001$).

The average age for telling 6 word was17.8 ± 3.0, without significant difference with appropriate age ($p = 0.510$).

There were average age for Neck taking 4.0 ± 1.5 months ($p<0.001$), Welter 7.1 ± 5.1 months ($p=0.212$), mean age of creep 7.4 ± 1.7 months ($p = 0.430$), sit down with the help of 8.2 ± 1.4 months ($p<0.001$), sit without help 9.5 ± 1.4

months ($p < 0.001$),mean age fours off 10.4 ± 1.4 months ($p<0.001$), walking 13.5 ± 2.1 months($p<0.001$). (Table 1)

Discussion

In this study, the mean age of developmental indexes for all premature LBW infants were significantly different with term and AGA.

Just the age of Welter, crawl, telling 2 syllables words and saying six words, in study group were not significantly different with standard indexes.

Atkinson and colleagues suggest that both body size, and feeding pattern effect on growth VLBW infants and the infants in the next years will have lower weight and height. [17]

In this study, developmental indices were not evaluated.

Chatelaine believes SGA and low birth weight is a public health problem and 10.8 percent of these infants would not have compensatory growth.

These problems determined by severe and permanent short stature and developmental delay. [18]

Sayjal (2000) showed that children with LBW have lower scores on cognitive ability than peers. [19]

Table 1. Mean age of developmental indexes in low birth weight (LBW) infants

developmental index	mean age of developmental indexes according to DENVER II (months)	mean age of developmental indexes in LBW infants (months)	P(Value)
Smiling	1.5	4.6±2.1	P<0.001
Telling two syllables words	9	11.7±1.9	p=0.139
Understanding the Means of "No" (avoid something with hearing "no»)	7	10.4±2.0	P<0.001
Say 6 words	15	17.8±3.0	p=0.510
Neck taking	3	4.0±1.5	P<0.001
Welter	4	7.1±5.1	p=0.212
Crawling	4	7.4±1.7	p=0.430
Sitting without help	6	9.5±1.4	P<0.001
Sitting with help	4	9.5±1.4	P<0.001
Flounder	9	10.4±1.4	P<0.001
Walking	12	13.5±2.1	P<0.001
Chase objects with eye	2	5.2±1.1	P<0.001
Hand Grip	4	7.6±2.4	P<0.001
Handoff objects	5.5	9.9±2.0	P<0.001
Recognition of mom	4	6.4±1.8	p=0.011
cooperate for dressing	12	16.1±2.6	P<0.001
React to their names	9	10.5±1.6	P<0.001

Hunt showed correlation between LBW a low IQ.

In his research on 108 LBW children, there were 6.4% very low IQ (below 70), 9.13% low IQ (84-70).

But children with normal IQ(>84); 12% had language problems, 12% cognitive problems, 21.4% visual-motor disability and just 36.1% were normal completely .[20]

Hulse and colleagues reported that children with extremely low birth weight and without disabilities in the development of language, movement, memory, visual-motor-perceptual) are weaker than their peers. [21]

Ford (1998) reported that extremely low birth weight infants clearly down on all aspects of motor skills in the first 4 years of life. [22]

Isle Ward (1994) showed that premature infants in the sensory orientation and adjustment of status forms of behavior that leads to less visual and navigation. [23]

A large study followed children born between 22 and 25 weeks until the age of 6 years old. Of these

children, 46 percent had moderate to severe disabilities such as cerebral palsy, vision or hearing loss and learning disabilities, 34 percent had mild disabilities, and 20 percent had no disabilities.
12 percent had disabling cerebral palsy. [11]
A long-term study demonstrated that the risks of medical and social disabilities extend into adulthood and are higher with decreasing gestational age at birth and include cerebral palsy, intellectual disability, disorders of psychological development, behavior, and emotion, disabilities of vision and hearing, and epilepsy. [24]
Standard intelligence tests showed that 41 percent of children born between 22 and 25 weeks had moderate or severe learning disabilities when compared to the test scores of a group of similar classmates who were born at full-term. [24]
Also People born prematurely may be more susceptible to developing depression as teenagers. [25] Some of these problems can be described as being within the executive domain and have been speculated to arise due to decreased myelinization of the frontal lobes. [26]
Studies of people born premature and investigated later with MRI brain imaging, demonstrate qualitative anomalies of brain structure and grey matter deficits within temporal lobe structures and the cerebellum that persist into adolescence.[27]
According to this study and another researches premature and LBW infants have many problems in their lives and it is important to pay attention to developmental indices.

Conclusion

Children with history of prematurity and low birth weight have more disability and developmental delay so they need to developmental screening tests.

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References

1. nichd.nih.gov. [homepage on the website]. Preterm Labor and Birth: Condition Information. [Retrieved 7 March 2015; 03/11/2014]. http://www.nichd.nih.gov.
2. nichd.nih.gov. [homepage on the website]. What are the symptoms of preterm labor? [Retrieved 7 March 2015; 11/06/2013.]..http://www.nichd.nih.gov/.
3. WHO.int. [homepage on the website]. Preterm birth Fact sheet N°363. [Retrieved 6 Mar 2015]. http://www.who.int.
4. nichd.nih.gov. [homepage on the website]. What are the risk factors for preterm labor and birth?. [Retrieved 7 March 2015. 03/11/2014. Cloherty, John P. (2012)]. http://www.nichd.nih.gov/.
5. Wilkins. P. Care of the Extremely Low Birth Weight Infant. Manual of neonatal care (7th ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & 146. ISBN 9781608317776.
6. theis "Reducing Perinatal and Neonatal Mortality" Check |url= value (PDF). Child Health Research Project Special Report. 1999.
7. Mathews TJ, MacDorman MF. Infant mortality statistics from the 2003 period linked birth/ infant death data set. Natl Vital Stat Rep. 2006 May 3;54(16):1-29.
8. Aizenman E, White WF, Loring RH, Rosenberg PA. A 3,4-dihydroxyphenylalanine oxidation product is a non-N-methyl-D-aspartate glutamatergic agonist in rat cortical neurons. Neurosci Lett. 1990 Aug 14;116(1-2):168-71.
9. Frye RE, Landry SH, Swank PR, Smith KE. Executive dysfunction in poor readers born prematurely at high risk. Dev Neuropsychol. 2009;34(3):254-71. doi: 10.1080/87565640902805727.
10. Marlow N, Wolke D, Bracewell MA, Samara M. Neurologic and Developmental Disability at Six Years of Age after Extremely Preterm Birth. N Engl J Med. 2005 Jan 6;352(1):9-19. CS1 maint: Date and year (
11. Bell EF, Acarregui MJ. Restricted versus liberal water intake for preventing morbidity and mortality in preterm infants. Cochrane Database Syst Rev. 2014;12:CD000503. doi: 10.1002/14651858.CD000503.pub3. Epub 2014 Dec 4.
12. Saigal S, Doyle LW. An overview of mortality and sequelae of preterm birth from infancy to adulthood. Lancet. 2008 Jan 19;371(9608):261-9. doi: 10.1016/S0140-6736(08)60136-1.
13. Gilbert WM, Nesbitt TS, Danielsen B. The Cost of Prematurity: Quantification by Gestational Age and Birth Weight. Obstet Gynecol. 2003 Sep;102(3):488-92.
14. Spencer E. Ante. Million-Dollar Babies. BusinessWeek. June 12, 2008. Retrieved 2010-1-24.

15. Frankenburg, William K.; Dobbs, J.B. The Denver Developmental Screening Test. J Pediatr. 1967 Aug;71(2):181-91.
16. "Denver Developmental Materials". Denver Developmental Materials. Denver Developmental Materials. Retrieved 15 July 2015.
17. Atkinson S A. Randall, Simpson J. Factors influencing body composition of premature infants at term- adjusted age. Ann N Y Acad Sci. 2000 May;904:393-9.
18. Chatelaine P. Children born with intrauterine growth retardation or small forgestational age: long term growth and metabolic consequences. Endocr Regul. 2000 Mar;34(1):33-6.
19. Saigal S, Hoult LA, Streiner DL, Stoskopf BL, Rosenbaum PL.. School difficulties at adolescence in a regional cohort of children who wewe extremely Low Birth Weight. Pediatrics. 2000 Feb;105(2):325-31.
20. Hunt JV, Cooper BAB Tooley WH. Very low birthweight infants at 8 and 11 years of age: role of neonatal illness and family status. Pediatrics. 1988 Oct;82(4):596-603.
21. Halasey CL, Collin MF, Anderson CL. Extremely low birth weight children and their peers: a comparison of preschool performance. Pediatrics. 1993;91(4):807-11.
22. Ford GW, Doyle LW, Davis NM, Callanan C. Very low birth weight and growth into adolescence. Arch Pediatr Adolesc Med. 2000 Aug;154(8):778-84.
23. Aylward GP, Hatcher RP, Leavitt LA, Rao V, Bauer CR, Brennan MJ, et al. Factors affecting neurobehavioral responses of preterm infants at term conceptional age. Child Dev. 1994;55(4):1155-65.
24. Moster D, Lie RT, Markestad T. Long-Term Medical and Social Consequences of Preterm Birth. N Engl J Med. 2008 Jul 17;359(3):262-73. doi: 10.1056/NEJMoa0706475.
25. "Depression linked to premature birth". The Age (Melbourne). 2004-05-04. Retrieved 2008-12-16.
26. Böhm B, Katz-Salamon M, Institute K, Smedler AC, Lagercrantz H, Forssberg H. Developmental Risks and Protective Factors for Influencing cognitive outcome at 5,5 years of age in very-low-birthweight children. Dev Med Child Neurol. 2002 Aug;44(8):508-16.
27. Spencer MD, Moorhead TW, Gibson RJ, McIntosh AM, Sussmann JE, Owens DG, et al. Low birthweight and preterm birth in young people with special educational needs: a magnetic resonance imaging analysis. BMC Med. 2008 Jan 30;6:1. doi: 10.1186/1741-7015-6-1.